NOTES ON TREE DISEASES

in

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by

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(Much of this material is confidential and none of it should be used for publication without permission of the writer.)

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INTRODUCTION

These notes were taken during a period of nearly seven months spent in western Europe from February 13 to August 31, 1939. The trip was made possible through a fellowship granted by the Oberlaender Trust of the Carl Schurz Memorial Foundation, Incorporated, Philadelphia, Pennsylvania. Most of the time was spent in Germany, but shorter visits were made to Holland, Switzerland, Denmark and Sweden, while a few days were spent in France en route home. Every possible courtesy and assistance was extended by the Reichsforstamt (Forest Service) of the German Government to facilitate observations in Germany. Many individuals helped and particular acknowledgement is made to Prof. Dr. Liese, Prof. Dr. Münch, Forstmeister De Marée, Prof. Dr. Heske, Oberforstmeister Johannsen, Oberforstmeister Dr. Querengässer, Herr von Schroeder and Dr. Zimmerman of Germany, Dr. Bürger and Dr. Gäumann of Switzerland, and Dr. Van Vloten of Holland.

The following pages are merely field notes which have not been carefully edited or analyzed for conclusions. Under certain topics the arrangement is not orderly, since notes made in one locality at different times will be separated by notes made elsewhere during intervening periods. Contradictions sometimes occur because of differences of opinion among European investigators consulted. Originally written with the idea that these notes would be used only by the writer, it has since seemed advisable to make the information available to a few other forest pathologists.

None of the material herein should be published without permission, because the notes contain unpublished information generously placed at the writer's disposal by various European investigators.

ABIES PECTINATA

In Forst Tharandt, Tharandt near Dresden, saw two trees about 50 ft. high suffering from the "fir disease." Dieback of leader and ends of branches, thin foliage, and general unhealthy appearance.

In Forst Proskau (el. 600 ft.), Proskau near Oppeln, which this species is native and reproduces well naturally, the tree is not much grown because the timber merchants prefer P. silvestris and the pulp mills P. excelsa. No Dreyfusia nüsslini seen here.

In the Staatsforst Landskron (see description under D. willkommii) where A. pectinata is native, naturally reproduced;

in mixture, and in its optimum there was no sign of the fir disease. No D. nusslini could be found and Hausser stated that it does not exist. He also stated that in Baden in the region of the Bodensee where fir is not native the insect appeared about 10 years ago and has become increasingly serious until now it is causing much injury.

According to Zimmerle in the Bodensee region where A. pectinata is not native the damage by D. nusslini is severe, but in the Black Forest (Schwarzwald) where the tree is native, the insect is present but is causing little or no damage. Schlenker also stated that there is considerable damage to A. pectinata in the Bodensee region by Pissodes sp. which attacks the lower half of the trunk, not the roots.

The Forst Langenbrand is in the northern part of the Black Forest (Schwarzwald); elevation 2400 ft.; precipitation 1000 mm. of which 500 mm. falls in the summer months. The forest is 60% A. pectinata, 30% P. excelsa, 10% P. silvestris and a little Q. pedunculata and F. silvatica. The usual mixture is fir and spruce or fir and pine. All these species are native here and reproduction is largely natural, little planting or sowing being necessary. L. europaea is not native and does not do well because the climate is too damp so it has practically disappeared from this forest. The fir is very fine, and the spruce though good is better in the southern part of the Black Forest. The worst pest in the forest is Dreyfusia nüsslini on A. pectinata. Many saplings are so heavily infected that they are moribund or actually dying but reproduction is so abundant and so many trees have so far been resistant that damage to the reproduction is not yet serious, although the future may be dubious. The insect appeared first about 10 - 12 years ago, apparently introduced on A. nordmanniana planted in nearby resorts.

According to Seeger, the Schwarzwald (Black Forest) was originally largely hardwoods, F. silvatica, Q. pedunculata, Acer pseudoplatanus, Betula verrucosa, Carpinus, etc., with a little P. excelsa, P. silvestris, and A. pectinata, but the natural stand composition was changed until the Schwarzwald became 90% silver fir. This was all right for a time but in the past 8 - 10 years, Dreyfusia nüsslini has appeared and is now so injurious to the reproduction that in Seeger's opinion the fir is finished (caput) in the Forst Emmendingen and in the entire Schwarzwald. He thinks the insect was introduced on Picea orientalis by a large nursery in the vicinity which distributed ornamental stock throughout Baden. The louse is native to the Caucasus.

In a stand of planted saplings (Forst Emmendingen) in which the insect was first found 3 years ago, the damage was already very severe with many trees moribund.

In the Forst Kaiserslautern (Bayer. Pflaz) an experimental plantation of A. pectinata established in 1912 was being destroyed by D. nüsslini. Münch thinks that this tree is doomed in localities where the climate is warm, which includes most of the Schwarzwald except at the higher elevations, and most of the rest of southern Germany. The louse is a native of the Caucasus on Abies nordmanniana and was introduced into Germany on ornamental stock. It is too wet in the Caucasus for the insect to be serious there, but it is destroying A. nordmanniana in southern Germany even more rapidly than A. pectinata.

In Switzerland, D. nüsslini is now damaging A. pectinata up to 600 - 700 m. elevation and is steadily moving higher. It first appeared in the lowlands and was brought in on Abies nordmanniana, the insect being native to the Caucasus. (Burger).

The degree of damage by D. nüsslini to A. pectinata in Switzerland is still controversial, some foresters considering it to be very severe while others think that it is not really serious enough to jeopardize fir (Gäumann).

In southern Germany where the annual precipitation is 1000 mm. or more there is little damage by D. nüsslini but where the rainfall is less the damage is severe. Whenever there is a dry season the insect becomes more widespread and damage more severe. This louse has been in Böhmen (Bohemia) for 90 years (Münch).

At Warnemunde on the Baltic where Abies pectinata is not native, Chermes nüsslini, was very severe on planted trees of sapling size. No larger trees were seen.

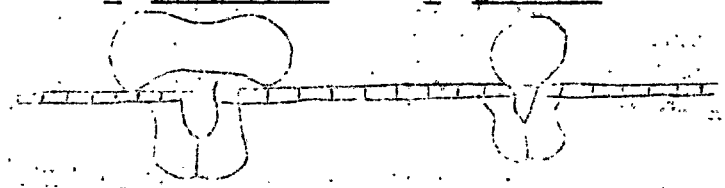
ADELOPUS GÄUMANNI

Van Vloten is studying the development of the fungus on the needles by means of killed and fixed material which is sent to him regularly from Grafrath near Munich. He stated that it had not yet been determined whether only needles of the current season can be infected or whether older ones can be also. In southern Germany the mountain and intermountain forms seem to be most susceptible (it is not yet known whether the coast form is infected at all), so Van Vloten has shipped about 1600 Pseudotsuga taxifolia transplants, grown from seed collected from trees of the coast form in Holland, into southern Germany where they have been planted close to infected stands. This should determine whether the coast form is also susceptible.

According to Wollenweber there are distinct differences between asci and ascospores of A. gäumanni and A. balsamicola

(nudus) as outlined in his letter. Perithecial differences are shown below:

A. balsamicola A. gäumanni



Münch is of the opinion that A. gäumanni is so destructive in southern Germany and Switzerland because the moist summer climate is unusually favorable to it. Consequently it will not be serious in northern Germany where the climate is drier. Also stated that the coastal as well as the mountain form of Pseudotsuga taxifolia is killed by the fungus.

At Grafrath near Munich in the experimental forest of the Forstbotanisches Institut, together with Münch, I examined an 11 year old stand infected with Adelopus. The fungus was first found here in May, 1938, and is just beginning. So far there was little or no visible injury except to an occasional tree on which there was considerable defoliation. Examination made on March 30, 1939. A few more trees were showing some brown needles. This stand was presumably the coast form but there was some of the mountain forms mixed in it. Perithecia were abundant on the 1937 needles and were just appearing abundantly on the 1938 needles, but were not seen on 1936 or older needles except rarely on 1936. This indicates that infection occurs only on needles of the season and possibly on 1-year-old but not on older. According to Münch there were no perithecia on the 1938 needles in November 1938 and these were the first he had seen. Adelopus was also seen on other trees in various places in the experimental forest, some of which were older but still in the sapling stage. The foliage of several poles windthrown during a recent storm was entirely free from the fungus, as was also the foliage on several branches broken off from 58-year-old trees. Münch has introduced a number of trees from a locality where there is no Adelopus to determine whether only needles of the season or older needles are also infected.

In the Forst Freising, Freising near Munich (el. 1700 ft.) on April 1, 1939 a number of stands of P. taxifolia were examined. In the nursery area where a number of exotics were growing there were about 40 12-year trees of the coast form with a light infection of A. gäumanni, indicated by only slight browning of the needles and very little needle cast. However nearby was another group of 12-year-old trees of the mountain forms very heavily infected and showing much browning or extremely thin foliage. The infection apparently began in 1933 or 1934. The 1938 needles had abundant but very

young perithecia; the 1937 needles were either completely cast or almost completely brown, the 1936 needles were partially cast or partially brown while the remainder were green, while the 1935 and 1934 needles showed a few perithecia but were still green. The foliage from a number of trees of the coast form, ranging from large saplings to poles to standards in stands in various places in the forest were examined but no Adelopus found.

In Forst Tharandt near Dresden, on the Douglas firs from sapling to pole size, both coast and mountain forms there was no Adelopus (4/5/39).

In Forst Proskau, Proskau, near Oppeln there was one small plantation (1/4 acre) of 30-year-old P. taxifolia (coast form). The trees were of good form but slow growth. No Adelopus found (4/11/39).

In the Neubersteich Park of Herr von Schroeder (Neubersteich, bei Gleiwitz, Ober Schlesien) there was a small plantation of P. taxifolia. When purchased the transplants were supposed to be the coast form, but the trees appeared more like the intermountain form. The stand now 15 years old has made poor growth, the trees being only 6 - 10 feet high. No Adelopus (4/12/39).

In the Forst Falkenberg, Falkenberg bei Oppeln, Ober Schlesien, in various groups of P. taxifolia in sapling and small pole stages up to 20 years old there was no Adelopus. Trees mostly coast form (4/12/39).

Rohde stated that both the coast form and the mountain forms of Pseudotsuga taxifolia are attacked by Adelopus but that damage to the coast form is slower. Rohde also thinks that Adelopus has been introduced from North America and is so severe in Europe because the tree is not native. He is puzzled however as to the manner of introduction. No Douglas fir plants have been introduced into Germany or Switzerland for decades, and why the fungus should remain quiescent for so long cannot be explained.

In the Forst Ravensburg, Ravensburg, near the Bodensee, visited on April 24, 1939, there are several small plantations of Douglas fir, all infected with Adelopus. Elevation 1600 ft., annual precipitation 1100 mm. The fungus apparently reached this forest from the older infections in Switzerland, carried by the wind. In a 25-year-old stand of the mountain form, trees 7 - 9 in. d.b.h., and 40 - 50 ft. tall, infection was severe. The last 5 growth rings on the stump were very narrow and the foliage was very thin. The buds had

not yet opened (hardwoods were all leafing out), the 1938 needles had a few perithecia, 1937 needles all with abundant perithecia, 1936 needles mostly cast, and 1935 and older needles all cast. Some of the most severely infected trees were being killed by Armillaria mellea. Most trees were heavily infected but in a few the damage was so far slight. In the upper crown of some trees only the 1938 needles remained, - all others cast.

A 25-year-old stand of the coast form, trees about 50 feet high, had grown at the rate of 2+ feet per year until 1938 when the height growth was only 1 foot. Although infection was general from the base to the top of the crown, few needles had been cast, so the damage as yet was slight, although in time it may be just as bad as in the previous stand. It is not absolutely certain that this was the coast form although it appeared to be.

In a 55-year-old stand, 12 - 20 in. d.b.h. and 100+ ft. high, coast form, the trees were still making excellent growth. One intermediate tree was felled but no Adelopus was found on the needles. According to Liese, in March 1938 an occasional infected needle was found on a tree felled in this stand.

In a stand of a few 8-year-old saplings, infection was light on some trees and heavy on others but according to Liese it has increased greatly since last year. Could not be determined whether the trees were the mountain or coast forms but they seemed to be mixed.

A plantation of saplings 8 - 10 years old was plainly a mixture, some of the trees being characteristic of the coast form and others of the mountain form. The latter trees were only 5 - 10 feet high and very heavily infected. Most trees had the 1938 needles green but with perithecia developing, the 1937 needles brown with abundant perithecia, and the 1936 and older all cast. The trees of the coast form were making a height growth of 2 - 3 ft. yearly and were 20 - 28 ft. high. Although the 1938-1934 needles inclusive all had perithecia, there was no browning or casting and no apparent injury. A few trees of the mountain form had lost all but the 1938 needles.

In the Forst Baindt near Ravensburg there was a 25 - 30 year old stand and all cones found on the ground were of the coast form. Many trees had already died, usually being finished off by Armillaria mellea. Others were dying, having lost practically all their foliage, others with thin yellowish foliage were making barely perceptible growth, while some were apparently not injured at all although the needles were generally infected. So far there had been a tremendous individual variation to the disease, but perhaps the seemingly resistant trees will

merely be slower in succumbing. On the vigorous trees which still retained all their needles, perithecia were common on the 1938 needles, abundant on the 1937 - 35 needles, but did not occur on the 1934 needles and the few of 1933 observed. No 1932 needles were found.

In the nursery of the Forst Baindt were a number of 3-year transplants which had been grown for 2 years (seedlings) at Eberswalde where there is no Adelopus and then planted in the spring of 1938 at Baindt. No perithecia were found on the 1937 needles, but an occasional 1938 needle had a few. This experiment by Liese to determine whether older needles as well as those of the current season can be infected may not be successful owing to the dropping of the needles after transplanting. 1937 needles were already sparse and no 1936 needles were found.

However Liese had found a tree in a plantation established in 1937 in the Forst Ravensburg. The stock came from Halstenbeck south of Hamburg where Adelopus does not occur. On this plant some of the 1936 needles were infected indicating that infection is not confined to needles of the current season.

Douglas fir is no longer planted in Württemberg, the policy being that of awaiting developments in the present stands to see if a resistant race can be found or if the disease will subside.

In March, a trip to Ireland in the general vicinity of Dublin was made by Liese to see the Adelopus disease there which he found to be just as bad as in Württemberg and Baden. Douglas fir is no longer planted in the Irish Free State because it has been doing so poorly, although it was not recognized that the trouble was the disease caused by Adelopus.

In the Forst Emmendingen (near Freiburg, Baden, el. 1200 ft., precipitation 550 mm.) there are numerous, scattered, stands of Douglas fir from a few hundred square feet to an acre or so in extent. A 10 to 12-year-old stand of the coast form covering a few hundred square feet was heavily infected with Adelopus, the disease being first noticed in 1936. Only the 1938 and 1937 needles remain, both with abundant perithecia. All older needles have been cast. No trees had died as yet in this stand but height growth for 1938 was about 1/3 of what it had been in former years. In a 30-year-old stand of the coast form a few hundred yards away there was no infection. A few 12-year-old trees close by this stand were also free from the fungus.

A 25-year-old stand of the intermountain form, trees 18 - 30 ft. high, average 20 ft., growth slow from start. Stand

was heavily infected with Adelopus, which appeared several years ago; in fact the stand was finished. Many trees were already dead and all of the remainder had only a few living branches in the top of the crown. These branches had only the 1938 needles, all older needles had been cast.

In a 20-year-old stand of the coast form all the trees were infected, having somewhat thin and brownish foliage. So far the damage had not been serious, although it apparently will be. A few trees of the intermountain form in this stand were almost completely defoliated and dying.

In a 47-year-old stand of the coast form (trees 14 - 18 in. d.b.h. and 85 - 90 ft. tall, good growth, good form) the foliage was generally infected and many needles cast, so that the crowns were thin when viewed from below, - there was plenty of light reaching the forest floor which under normal conditions would have been completely excluded. Although no trees had died as yet in this stand, a cross section showed that diameter growth was reduced sharply in 1934, and since then the growth rings have been barely perceptible. This stand presented by far the most alarming condition seen so far, - damage to a stand of practically merchantable size, the coast form, and every tree affected more or less.

A 10-year-old stand about 10 kilometers distant on the other side of the valley, on the slope of the mountain known as Kaiser's Seat, was free from Adelopus but abundantly infested with Chermes cooleyi.

According to Seeger he saw this same disease (Adelopus) first in 1911 on a Douglas fir in his father's garden at Karlsruhe.

In the Forsts Ravensburg and Emmendingen some of the less severely infected stands of sapling size look like the stand at East Willington, Connecticut.

The greater amount of rainfall in May and June in southern Germany, Switzerland and Ireland, together with considerable rainy, or humid and cloudy weather throughout the spring and summer months, coupled with the fact that Douglas fir is so far from its natural range seems to offer the best explanation for the virulence of this fungus in Europe as compared to the United States.

In the Forst Raperswil, Adelopus was first noticed in 1929 according to Helbling. This forest lies on the north side of the Zurich See near the eastern end in Switzerland. Elevation 1500 feet, annual precipitation 1500 mm. and examined

on May 23, 1929. Saw 15 trees planted in 1921, which were from 20 - 30 feet high and seriously infected, with only 1938 and 1927 needles remaining. Ten of the trees had just been felled because they were making such slow growth, although they had not actually been killed by the fungus or by a secondary agent. Some 29-year-old poles in mixture with P. excelsa and A. pectinata had made a good growth for 14 years, but then growth began to slow down and for the last 4 years the rings were very narrow. The trees were being cut because of slow growth. Foliage thin, all needles cast except 1938, 1937 and a few of the 1936. Nearby were some 50-year-old poles with the foliage in the same condition as the foregoing. In another part of the forest there was a 47-year-old stand with very thin foliage resulting in much light coming through the crown canopy. Very heavy needle cast. Nearby were a number of saplings from 10 - 15 feet high. On most of the trees only the 1938 and 1937 needles remained, but on a few only the 1938 needles were left, - all others cast. Foliage had a yellowish brown color. All Douglas fir in this forest seemed to be of the coast form and according to Helbling the Swiss Forest Service has purchased only coast seed for planting at the lower elevations.

Abies pectinata was intermingled with the last saplings discussed and no A. balsamicola was found on it in the typically saprophytic habit so characteristic of this fungus on Abies in the U.S. However on two somewhat suppressed saplings a fungus resembling Adelopus was apparently weakly parasitic on the 1937 and older needles. Some material left with Gäumann and some should be sent Wollenweber for identification. Found at time of second examination of this stand, June 7, 1939.

In a private forest near Zug, Switzerland there was a 20-year-old stand of P. taxifolia, coast form, with nearly every tree heavily infected. Only 1938 and 1937 needles remained. Contrary to most other places seen in south Germany and in Switzerland in the spring, there were no perithecia on the 1938 needles in this stand. The foliage was very thin and had a yellowish cast although the 1938 needles were a normal green in color.

Not far away in the communal forest of Zug at Risch in Kirchberg was a 51-year-old stand of coast P. taxifolia, with an average d.b.h. of 33.4 cm. which was heavily infected, the foliage being yellowish and so thin that much light came through the crown canopy. Diameter growth has sharply reduced in the last few years. These trees will not be felled but will be held to study further developments. According to Badoux no Douglas firs have been killed by Adelopus alone here or elsewhere in Switzerland, but after they have been greatly weakened the actual death is brought about by a secondary agent such as Armillaria mellea.

The present policy of the Swiss is "wait and see." Douglas fir is no longer planted in pure stands, only in mixture. Badoux thinks that some trees are showing signs of recovery from the disease. According to Burger and Badoux the loss of Douglas fir in Switzerland is not a really serious calamity (nothing like the possible loss of P. strobus), because while the tree grows rapidly the technical qualities of the wood are naturally low. Larch is a better wood at younger ages.

In the grounds of the Hotel Belvedere at Grindelwald, Switzerland (el. 3500 ft.) there was a group of P. taxifolia poles of the mountain form (cones with reflexed bracts) but there was no Adelopus on the needles.

According to Burger the disease appears no differently in other parts of Switzerland than it does at Rapperswil and near Zug. At Zofingen, Kanton Aargau and at Aarberg, Kanton Bern, the diseased trees are mostly individual ones in a mixed stand but at Schaffhausen they are in pure stands of small extent.

According to Gäumann Adelopus was first found in Switzerland at Aarberg in the year 1925. It then apparently spread into southern Germany and Austria on the moist winds of spring and summer from the southwest.

The fungus is probably so much more virulent in Switzerland and southern Germany because of the pronounced oceanic climate of the region as compared to the United States. In Munich it rains about every other day during the spring and summer.

According to Münch, Adelopus was first known in Switzerland in 1925 and must have been there several years earlier at least.

There are no plant quarantine regulations in Switzerland and no records of entry of plants so the fungus could have easily been introduced from the United States or Canada.

In the Forst Ochsenhausen in Württemberg there was a 42-year-old pure stand of Pseudotsuga taxifolia (coast form) in which Adelopus was rather severe, the foliage being noticeably thin. The disease was first noticed in this stand in 1937. In another part of the same locality was a 42-year-old pure stand of P. taxifolia (intermountain form). Of 30 trees counted 14 were completely dead and the remaining 16 were barely alive from attack by Adelopus. No Armillaria mellea found on these trees. These trees were from 25 to 30 feet high and had grown slowly because immediately adjacent

was a stand of the coast form of exactly the same age but 50 to 60 feet high and much less infected with Adelopus so far. The disease was first found in the intermountain stand in 1933-34 and in the coast stand in 1937. The coast form so far has been more resistant than the intermountain form but the end may be the same. These stands were in the District Wildbuch of the forest. Annual precipitation 850 mm. and the elevation about 1950 feet.

At Warnemunde on the Baltic where there were Douglas firs of sapling size, both coast and mountain forms, no Adelopus was found.

ARMILLARIA MELLEA

Van Vloten is carrying on extensive investigations with cultures from many hosts and from many parts of the world. He has found that there are different strains of the fungus as shown by differences in culture, but that differences in pathogenicity are not consistent within a strain but are apparently controlled by other conditions such as temperature, soil moisture, etc. A strain which was not pathogenic at first, then produced a fructification, and strains started from single basidiospores from this fructification were pathogenic. However no strain was pathogenic which did not produce rhizomorphs.

He grows the fungus on long blocks of wood in large test tubes with water in the bottom of the tube. Almost any common hardwood will do, but was using beech. Plants are grown in soil and are inoculated by burying small pieces of the infected wood blocks in the soil.

He finds that A. mellea does not enter a small root, then progress to a larger one, and so on to the root collar; but that each infection is relatively localized so that a tree is not damaged unless so many roots are infected that the root system is largely destroyed, or unless infection occurs close to the root collar.

In Forst Langenbrand (northern Schwarzwald) this fungus was found killing an occasional P. silvestris sapling.

In the Forst Kaiserslautern (Bayer. Pfalz), A. mellea is a primary parasite on Pinus silvestris when this tree is planted on land previously in hardwoods (beech). Then the fungus can kill even the most vigorous saplings. It cannot kill large trees, unless they have been weakened by other agencies. Statement by Münch.

See also notes on Larix leptolepis.

CENANGIUM ABIETIS

According to Van Vloten, Cenangium abietis does not become epidemic and damaging in Holland, but does occur on branches of Pinus silvestris that are beginning to die from shading (natural pruning).

The epidemics of die-back of Pinus silvestris branches which occur periodically in northern Germany are entirely dependent on insect attack. Cecidomya brachyntera Schw. mines the lower part of needles down to the stem; infection by Cenangium abietis follows almost immediately. It is only when the insect is epidemic that there is much damage by C. abietis. The insect is most prevalent during dry years. This has been briefly mentioned in a publication (Liese, J. Zum Triebsterben der Kiefer. Der Deutsche Forstwirt 17:381 - 383. April 9, 1935).

C. abietis is epidemic on P. silvestris during one or two years, then for several to a number of years the dieback caused by it is difficult to find. Relation to Cecidomya is as has been stated by Liese (Münch).

CERATOSTOMELLA ON QUERCUS

At Pechteich, near Eberswalde there is a stand of 100-year-old Quercus robur which is badly diseased by what is probably Ceratostomella, possibly C. querci or C. merolinensis as described by Georgevitch in Jugo-Slavia. Ceratostomella is regularly isolated from the discolored vessels. According to Zimmerman the first indication of the disease is a raised place in the bark from a few inches to a foot or more in length with a pronounced sap flow which precedes this. An examination shows that the cambium has been killed for a quarter of an inch to an inch circumferentially and up to a foot or more in length vertically. Callousing then begins but there is no further killing of the cambium. Some of the vessels are discolored (dark brown to black) and several of these lesions may occur one above the other with the discolored vessels connecting them. Tyloses are also developed prematurely in the vicinity of the discolored vessels. Affected trees die slowly, branch by branch, until they must be removed and it is an axiom of foresters that as soon as the first lesion appears on a tree it is doomed. The disease is widespread in northern Germany and is very serious because the wood of infected trees is valueless for furniture owing to discoloration and poor grain, so that it must be used for fuel, posts, ties, etc.

In Forst Freienwalde near Eberswalde there is a very fine stand of 280-year-old Quercus robur from which 9 - 10 trees are cut yearly for furniture veneer, the best of the wood bringing a price of 800 RM per cubic meter and is sold by the

furniture manufacturers as Spessart oak. Some of these trees showed the lesions caused by Ceratostomella (?) with the evidence of sap flow (saftfluss) although most of them were free from it. Diseased trees only bring a price of 200-400 RM per cubic meter.

CERATOSTOMELLA ULMI

There is an extensive project on breeding and selecting elms to obtain a variety resistant to C. ulmi at the Landbouwhoogerschool, Wageningen, Holland. Engineer N. Krythe is in charge of the work which was begun 3 years ago in 1936. Ulmus pumila is used in various crosses but U. parvifolia cannot be because it flowers in the late summer or early autumn while all others flower in the spring.

The entomological investigations which were supervised by Prof. Dr. Roepke have been discontinued because they offer little hope of anything practical for control. He stated that the elm is of great importance as a shade and ornamental tree and for planting along dikes. The wood is widely used for implement handles and other products. Hardwoods are difficult to grow in Holland; oak is slow, ash does not do well, beech does not furnish a really satisfactory wood, while willow and poplar although they grow well do not furnish wood that can be used for the same purpose as elm. To Holland and also to Belgium the elms are of primary importance; being far more valuable than in other European countries, all of which have hardwoods economically more valuable than elms.

Roepke stated that the law which requires the prompt removal of infected trees and then either peeling off the bark or storing the logs in water, has markedly retarded the spread of the disease but cannot stop it. Statistics are available to prove this. Also the removal of infected trees has greatly improved the appearance of the landscape by eliminating the dead and dying individuals. Roepke estimated that in 20 years more, the elms of Holland will be practically all killed.

Nearly all the elms in Holland are Ulmus campestris var. hollandica which have been propagated vegetatively usually by layering, less frequently by grafting. Consequently the trees are largely of one clone, or possibly 2 to 3 to a few clones. Roepke and Van Vloten think that this explains why the disease has been so much more severe in Holland and in Belgium than in Germany, France and particularly in England where the elm population is not only a mixed one within each species but more than one species occur.

Van Vloten stated that only the last year ring is active in conduction, i.e., in 1939 only the 1938 ring and the one formed in 1939 take part in the ascent of sap. Also that the fungus

does not spread either inward or outward from one ring to another and that discoloration in 5 successive rings would mean that the tree was newly infected each year for 5 successive years. Frandsen (an entomologist) disagreed with this because discoloration of the ring of the current season has been found before any beetles have emerged to feed in the axils of the twigs and thus introduce the fungus.

Frandsen's doctorate dissertation on Scolytus scolytus and S. multistriatus is now in proof. S. scolytus is easily killed by high temperatures and low humidities while S. multistriatus is very resistant to such conditions which probably explains why S. scolytus, although most probably introduced into the United States has not become established while S. multistriatus has. Both beetles are resistant to high temperatures in the larval and pupal stages. The adult beetles of both species do not emerge from stems until the air temperature reaches 20° C. S. scolytus attains its maximum emergency at 25° C. and then declines until emergence ceases at 30° C., while S. multistriatus also reaches a peak at 25°, carries on at the same rate to 30° and then stops abruptly.

Infested stems must be immersed in water for seven (7) months to kill both species. Adult beetles will remain alive for 14 days immersed in water, for 12 days floating on water, and for 8 days in Petri dishes. If infested stems are buried in the ground to a depth of 30 cm., the beetles will emerge from the stems and make their way to the surface.

The adult beetles will eat through 2 annual rings when feeding in the axils of the twigs. Spraying with arsenicals (lead arsenate) is of no value in preventing the beetles from feeding in the axils of the twigs. Brush treating the bark of stems with various compounds (coal tar, paradichlorobenzene in kerosene, etc.) in some cases actually increased colonization by beetles and those chemicals which somewhat reduced colonization did not do so sufficiently to justify the cost of use. No chemical prevented colonization.

At Baarn saw the resistant Christine Buisman elm (No. 24) and Dr. Koning discussed the work on C. ulmi. Dr. Went who is in charge of the work was away in Switzerland. Through 1938, 50 per cent of elms in Holland had been killed by the disease. At Baarn they feel practically sure that Ulmus campestris var. hollandica which comprises nearly all the elms in Holland is only one clone.

According to Wollenweber the first infections of C. ulmi in Germany centered around places where the very susceptible U. campestris var. hollandica were established having been imported years previously from Holland. The worst infection centers are

still in cities where hollandica was common. The disease spread from Holland to Germany in various ways, among which might have been the transportation of wood or wood products, wrappings around plant stock, and the slow natural movement of the beetles. No hybridization work is being done in Germany, - this is all left to Holland.

Infected elms have to be removed. The trees are marked in summer and cut in winter. This has undoubtedly retarded the progress of the disease. For example 12 years ago the disease appeared in Hannover but on the advice of Wollenweber all the diseased trees were cut within two years. No further infection was found for 6 years when a small outbreak was cleaned up. Only an occasional diseased tree has been found since.

Eastern Germany is still largely free from the disease. In the alpine region (Tyrol) there is no infection as yet even though Ulmus montana (scabra) which predominates there is known to be susceptible. (Too cold for beetles? J.S.B.) Elms will not all be destroyed in Germany by far. Many trees will remain healthy even in a place like Berlin where infection is so prevalent.

Fungus rarely, if ever, moves radially either inward or outward from ring to ring (Wollenweber).

Both at Baarn and at Berlin - Dahlem it is necessary to artificially inoculate elms in the test plots, because beetles are now so much less abundant because of the removal of infected trees.

Along the bottom lands of the Elbe River, in Forst Wörlitz near Dessau, is a mixed hardwood stand with a high percentage of Ulmus campestris, some oak, beech, Carpinus, ash, birch, poplar, etc. These bottom lands are usually flooded once or twice a year, so that the elms have developed a shallow root system, and are dependent for vigorous growth on a high water table resulting from the yearly floods. Ceratostomella ulmi was first found in this forest in 1930. From 1931 until January 1938 there were no floods, thus the water table was lowered which was also accentuated by deepening the Elbe for navigation. Floods came again in January and September 1938. This long period with a low water table caused decline in vigor and slow growth of the elms. Tyloses formed in the wood and Liese is convinced that the reduced vigor of the trees is responsible for the severity of damage by C. ulmi here and in similar locations. The disease was particularly bad in 1930, 1934, and 1937. In 1938 and previous years 5000 cu. meters or about 5000 trees have been removed annually without getting out all that have been killed.

In the forest belonging to Graf Durckheim near Steckby, there is a large area of hardwood forest, 85 per cent Ulmus

campestris, on the bottom land along the Elbe River. So many elms have been killed and so many are now infected, that all elms in the forest are to be cut within the next few years and replaced by other hardwoods. Dürckheim attributes the severity of the disease to the artificial deepening of the Elbe and the long period without the customary floods, both of which have lowered the water table. The elms were weakened because they could not readjust their root systems to this sudden change, and consequently were extremely susceptible to C. ulmi.

Only the last year-ring conducts water, i.e., in 1939, the 1938 ring and that formed in 1939 (Münch). Around Munich he has observed no relation of water table to disease, for in the Englischer Garten the number of trees affected around the lake has been even higher than elsewhere.

In the Englischer Garten in Munich the elms are mostly U. montana from 100 to 150 years old, although some of them looked older to me. Each year a few trees become unsightly through dieback of some of the larger branches and are removed. Ceratostomella ulmi was first found in this garden and in Munich in 1929.

In Saxony, or at least around Dresden, the damage from the elm disease is lessening and there will be plenty of elms left. The susceptible ones were killed rapidly while the resistant or possibly immune individuals now remain (Franke).

In Ober Schlesien damage by the elm disease has so far been slight and does not seem to be increasing (Von Schroeder).

Ulmus campestris is now being planted by Rohde along with other hardwoods in the Forst Hersfeld near Kassel, because the elm disease is not severe in this locality. Annual rainfall is less than 600 mm. Some trees are diseased in Kassel and have been removed.

The elm disease is widespread in Switzerland and doing considerable damage largely through hastening the death of old trees of U. campestris quite widely used as a shade and ornamental tree. The native U. montana which is a component of the hardwood forests seems to be relatively resistant. However montana is a poorly defined and understood species (Gäumann).

U. montana was first thought to be relatively resistant in Munich when the elm disease first appeared there, but later developments have shown it to be only somewhat less susceptible than U. campestris. It succumbs more slowly (Münch).

The elms along the canals and in the Vondel Park in Amsterdam were examined on June 22, 1939. Nearly all the trees seen were mature or overmature Ulmus campestris var. hollandica, but not a

single wilted branch was seen. Branches had been removed here and there on various trees but the reason was not apparent. No more branches cut off than would be found in shade trees of any species in a city. Furthermore there were no gaps in the lines of trees indicating removal of entire trees. According to Van Vloten damage by C. ulmi in Amsterdam has been insignificant when compared to the rest of Holland but the reason is unknown.

In Cleve, Germany, no indications of the disease were seen on June 24.

Ceratostomella ulmi is unknown as yet in Sweden. Elm is common as a shade tree and in southern Sweden as a forest tree. All the forest trees which are natural reproduction and most of the shade trees are U. montana which is the only native elm on the mainland. On the Islands of Oland and Gotland in addition to U. montana, two other species viz U. campestris and U. lacvis = effusa are also native (Lagerberg).

In Halle am Saale no indications of C. ulmi were seen on any elms along the streets. Up to July this had been the wettest spring and summer for 33 years in Halle and other parts of Germany.

In 3 hours of walking through the Englischer Garten in München on August 11 and 13 no evidence of elm disease was seen except in the vicinity of the lake. Two trees were noticed which were practically dead with only a few living branches which showed only a few twigs with yellowed or wilted leaves of this year. Nearly all the branches had died in previous years. The two trees were overmature. In a few more large trees an occasional branch with yellowed or shrivelled leaves was seen. In other parts of the park nothing but branches which had died in previous yeans were to be found, - no new yellowing. Whether the dead branches were caused by C. ulmi could not be determined without climbing the trees. The spring and summer has been exceptionally wet in Munich.

While driving from Fontainbleu to Versaille via Belle Epine in France on August 27, there were abundant evidences of elm disease among the trees along the road. Many dead trees, others with dead branches of last year or older, but branches with wilted leaves indicating attack this season were extremely rare. Also there were numerous large sycamores and beeches dead, but no time for investigation. Necessary to push on to a channel port.

CHERMES COOLEYI

A stand of very fast growing 35-year-old Pseudotsuga taxifolia (coast form) in the Forest of Kootwyk, Kootwyk, Holland, was very severely attacked by Chermes cooleyi about 1935 as was evidenced by several narrow growth rings. The epidemic had subsided completely and there were only slight traces of the current presence

of the insect in February 1939.

Pseudotsuga taxifolia (coast form) in the state forests of Stroe and Speulder Bosch in Holland was infested with Chermes cooleyi. The mountain forms of the tree were free from this insect, except that an occasional tree of the intermountain (caesia) form was lightly infested.

Pseudotsuga taxifolia (coast form) saplings and small poles up to 20 years old in Forst Falkenberg, Falkenberg bei Oppeln, Ober Schlesien, Germany, were not infested with C. cooleyi (4/12/39).

In the Forst Emmendingen (Baden, Germany) on the slope of the mountain known as Kaiser's Seat, a 10-year-old stand of Pseudotsuga taxifolia (coast form) was heavily infected with Chermes cooleyi, although there was no apparent damage to the trees, which were still making good height growth. The planting stock originally came from Halstenbeck near Hamburg. In 1929 and 1930, this nursery imported a great deal of Douglas fir from Scotland so that is undoubtedly how the aphid reached Emmendingen.

CRONARTIUM ASCLEPIADEUM (PERIDERMIUM RINI)

Liese has conducted experiments with this fungus at Eberswalde. Cross pollinated trees without infection with those infected. Then raised seedlings and when trees were of sapling size inoculated with the rust. 70 per cent were susceptible, so it is now forbidden to collect seed from Pinus silvestris trees infected with this rust.

In Forst Proskau, Proskau near Oppeln (el. 600 ft.) where P. silvestris is the most important tree, P. pini was at one time very severe, but it is of little consequence now because infected trees have been consistently removed during thinnings for many years. Scotch pine is first thinned at an age of about 15 years and then every 3 years.

Peridermium pini, once fairly prevalent in Barenthoren on Pinus silvestris where the Dauerwald method is practised, is now relatively rare because for about 60 years infected trees have been removed yearly as found. Barenthoren is near Zerbst, in Anholt, Germany.

CRONARTIUM RIBICOLA

In Holland, damaging infection of Pinus strobus by C. ribicola results only from Ribes nigrum. The various varieties of red currants can be grown close to pines without any danger. (Van Vloten).

In Koninklyk Royal Park (near Apeldoorn, Holland), there was a fine uneven-aged stand of P. strobus in which a few trees each year are killed by rust, the infection coming from a small number R. nigrum about 3/4 mile distant. Tuberculina maxima had prevented aecial formation on several cankers; seemed to be more effective than in the western United States.

Because there are no wild Ribes in Holland, control of blister rust would be quite simple. However, R. nigrum is everywhere in farm gardens and is highly prized so that planting P. strobus is given up. Unfortunate because this tree is excellent, yielding a quality of wood not found in Europe and reproduces well naturally.

In Germany infection of P. strobus comes only from R. nigrum and not from the various varieties of red currants. There are no wild Ribes in Germany but R. nigrum cannot be eradicated because it is highly important as a source of fruit to the farmers, while P. strobus is scattered in small plantations and is not essential to timber production. If P. silvestris was attacked Ribes would be eradicated (Liese).

In the spring of 1938, Liese sowed seed of P. strobus from 25 different localities in the United States, Canada, and Germany, and in October 1938 inoculated them with sporidia from Ribes nigrum, to determine whether or not there are differences in susceptibility, or possibly a resistant strain that could be used for establishment in Germany. When seen in March, 1939, the various lots of seedlings showed decided differences, varying from abundant needle spots on some to only a few on others. Liese is depending on the number of needle spots to determine susceptibility or resistance. However under natural conditions one needle spot can be just as damaging, or sometimes more so than several to many, and it is still unknown whether there is any relation between susceptibility of needles and susceptibility of bark.

Most varieties of red currants cause no infection on Pinus strobus, and none of them cause significant damage. R. nigrum is responsible for all the damage in Germany. There are a few wild Ribes on chalk soils in the Bavarian Alps, particularly R. alpinum, but not of much consequence. P. monticola is much more susceptible than P. strobus in tests made in Bavaria. Münch believes there is direct aecial inoculation, because he commonly finds no decrease in the degree of infection as distance from R. nigrum increases and also finds infected pines where there seem to be no Ribes close enough to account for the infection. However the unusually moist weather in southern Germany could explain the first and a really careful hunt for Ribes would probably alter the second (J.S.B.).

In the experimental area of the Forstbotanisches Institut at Grafrath, near Munich, there were 12-year-old P. peuce which had been exposed since the beginning every year to heavily infected R. nigrum, 5 to 40 feet distant. There were (3/30/39) only a few blister rust lesions on these trees and the lesions were small. The trees were of good form and good rate of growth, although they had not grown as rapidly as P. strobus. Pinus excelsa of the same age close by also was showing strong resistance to blister rust but there were only a few trees left, - the others having been killed by cold. All P. monticola and P. strobus had been killed long ago by blister rust. There were a number of 2-year seedlings of P. strobus grown from seed collected from infected and uninfected mother trees in the general region of Munich, to determine whether there may be resistant races. So far no conclusions have been drawn, but with R. nigrum so close it will be a miracle if all these seedlings are not killed.

The Ebersberger Forst at Anzing near Munich occupies a level area of about 10000 hectares at an elevation of 1600 feet. Mostly Picea excelsa in younger age classes because nearly all the spruce had been killed by the nonne moth in 1893 and had to be replanted. There were also several stands of P. strobus scattered throughout the forest, which were composed of trees of good form and satisfactory rate of growth. No wild Ribes in the forest. From a 44-year stand trees 8-14" d.b.h. and 40-60 ft. high, the cutting of all infected trees was just being completed in late March 1939, resulting in removal of 50% of the stand. Remainder of the trees were uninfected and there were sufficient trees to make a satisfactory stocking for the final crop because from this age on damage is slight, most infections on the branches dying out before the main stem is reached. Nearest Ribes (R. nigrum) 4 kilometers distance. All trunk lesions were 20 feet or more above ground level. Blister rust has been present in this forest for 30 years and was first found in northern Germany about 1880.

In a 33-year stand at a distance of 1.5 kilometers from R. nigrum over half the stand had just been cut because of blister rust infections, but a fairly dense stand still remained. Wood sold for veneer cores. A 31-year stand at a distance of 0.5 km. from R. nigrum was no more heavily infected than the two stands previously discussed. In a 27-year-old stand at a distance of 2 km. from R. nigrum from which the infected trees had not yet been removed (except the dead for peasant's fire wood), the number of infected trees seemed about the same as in the other stands.

In the Forst Freising, Freising near Munich (el. 1700 ft.), on April 1, 1939 a group of 100 8-year-old P. strobus was examined rather carefully and only 1 blister rust lesion found.

These trees are 500 meters from red currants (Rothe Hollandische) and 3 kilometers from black currants (R. nigrum). In another part of this forest was a 52-year stand of P. strobus of good form, rapid growth, satisfactory stocking, and well self-pruned. R. nigrum is 5 km. distant and an occasional tree is removed yearly because of blister rust. Not enough trees infected to impair the productive capacity of the stand.

In a 9-year-old plantation of P. strobus, trees from 8-12 ft. high, in the Forst Tharandt near Dresden, there was one dead and one dying tree with lesions just above ground level, infection entering through a side branch. Nearest farm was 2 km. distant but it was not known whether there were any Ribes nigrum there. Close to the town of Tharandt, P. strobus with R. nigrum close by were practically ruined.

In the Neubersteich Park of Herr von Schroeter (Neubersteich, formerly Neoborowitz, bei Gleiwitz, Ober Schlesien), 81-year-old Pinus strobus on a moist, sandy soil has made remarkable growth. The trees were from 24 - 34" d.b.h. and contained 3 times as much cubic volume as native Pinus silvestris immediately adjacent on the same soil. This stand was free from disease until 1900 when a forester's house with red currants (not Rothe Hollandische) was built 300 meters distant. Since then an occasional lesion has appeared and the infected trees are now removed, but the rust requires many years to girdle the stem of these large trees, so that the infections have not affected the productive capacity of the stand. In a 20-year stand with red currants 500 meters distant in an orchard there was an occasional infected tree but the stand was not damaged.

There is no Ribes nigrum in Ober Schlesien because the climate is too cold and dry. Annual precipitation 800 mm.

In the Forst Schelitz, Schelitz bei Oppeln (Ober Schlesien) there are very fine stands of P. strobus. The forest is largely flat, el. 180 meters, annual precipitation 650 mm. The white pine was originally planted by Forstmeister Meinecke. At one place there was a splendid 140-year-old stand on a light, sandy soil. The trees have fine form (long clear length with little taper) and there is remarkable natural reproduction under the stand and for a distance of 500 meters and more away from it. Only a rare blister rust infection is found from time to time coming from red currants in a garden 800 meters distant. No damage to stand. At another place there was a 141-year-old stand with an excellent understory of saplings only 10 meters from a number of red currants in a garden. An occasional blister rust infection has been found in the reproduction, but the trees are so numerous that no loss results. Nearby was 3 hectares of 20-year-old natural

reproduction on wet, peat soil 2 meters deep. Trees of large sapling and small pole size. A 15 minute search in this stand showed only one infected tree with a lesion on the main stem near the base which had entered from a side branch. Same red currants as above from 150-300 meters distant.

In the Tiergarten section (200 hectares) of the Forst Falkenberg, Falkenberg bei Oppeln, Ober Schlesien, there is abundant P. strobus up to 140 years old. Measured one tree in an open stand, 140 years old and 44 inches d.b.h. - the largest known here. There was abundant natural reproduction from seedlings to large saplings under the open, old stands and at considerable distance away. In 1 1/2 hours in this area only 3 blister rust infections were found, all on branches. The aecia were just breaking open on one branch in sunlight but had not appeared on other two which were in shade. Red currants were within 350 meters of one infection and 500 meters of the other two. This is as close as red currants occur. According to Graf Praschma it is only rarely that an infected tree is found here.

In Ober Schlesien saw a few trees of Pinus peuce in several different places. Good form no blister rust, but growing from 1/2 - 2/3 as rapidly as P. strobus.

In Stastsforst Landskron (see description under D. willkommii) there are scattered P. strobus from seedlings to large poles but blister rust has never been found. No black currants or wild currants, and there are only a few red currants in an occasional garden 3 or more kilometers distant.

In the Forst Hersfeld and the Forst Richthof (a private forest) both near Bad Hersfeld there are only a few scattered P. strobus but they are generally infected with blister rust because R. nigrum is abundant in the gardens of nearby farms and villages.

In the Forst Emmendingen (Baden) a few 40-year-old Pinus strobus were examined and several had blister rust lesions on the trunk which would kill them in a few years. These lesions were quite old, since they occurred from 4 to 8 feet above ground level. According to Seeger, P. strobus was once commonly planted in this forest but it has been nearly all destroyed by blister rust, and the tree has been abandoned. R. nigrum is common in the gardens of nearby farms. Seeger thinks that the pines are often infected through hail wounds on the branches!

In the Forst Kaiserslautern (Bayer, Pfalz; precipitation 700-800 mm.) an experimental plantation of P. strobus was established in 1912. The stock was bought from Halstenbeck near Hamburg, and was already infected with C. ribicola in the nursery. Since that time infected trees have been removed yearly and new infections

have appeared although the nearest Ribes are red currants 4 kilometers distant. However the infections have not been numerous enough to impair the productive capacity of the stand. R. nigrum does not grow in this region because it is not moist enough and the soil is too sandy.

In a 20-year-old stand of P. strobus within a kilometer of a farm garden with red currants, no infected pines were found, and according to Münch none have ever been seen in this stand.

In the Forst Trippstadt (near Kaiserslautern, Bayer. Pfalz) P. strobus is now in the fourth generation. The first trees were planted in 1765 and none remain. The second generation, 147 years old, was planted but the seed was collected from trees of the first generation. The third generation, 100-110 years old, was naturally reproduced and the fourth generation, 1 - 20 years old, was also natural reproduction. The stand occupies 5 hectares. One 147-year-old tree which was measured had a circumference of 3.1 meters. Others were equally large.

There were trees of all ages scattered throughout the stand which were infected with blister rust, most of the lesions being on the main stem. The oldest lesion seen was on 25-year-old wood of a large pole and the youngest on 3-year-old wood of a sapling. New infections are found in this stand from time to time, but not enough trees are damaged or killed to affect the productive capacity of the stand. The nearest Ribes are red currants in a garden 0.5 - 1.0 kilometers distant but according to Münch, no infection has ever been found on these. Other red currants are much farther removed and the agricultural district where there are many acres of red currants is about 40 kilometers distant over two ranges of hills. The red currants do not seem sufficient to account for the amount of infection found here as compared to other places where reds are close to pines.

In the Exotengarten at Weinheim near Heidelberg there were originally 280 Pinus lambertiana but only three were left, the others having been killed by blister rust. P. monticola cannot be grown here because of the rust, - all trees of this species having been killed. However, there were quite a number of P. strobus remaining and infection on these was light despite the presence of a great many red currants and some black currants in the vicinity. One stand of P. strobus about 25 to 30 feet high within 30 to 50 feet of a hundred or more red currant bushes showed no infection during a 15 minute examination. However there are too many Ribes here for the perpetuation of even the less susceptible P. strobus.

In the Stadtforst Raperswil, Switzerland, there is severe damage to Pinus strobus, so that the tree is no longer planted. No inquiry was made, but Ribes are undoubtedly abundant in farm gardens here.

In the communal forest of Zug at Risch in Kirchberg, Switzerland, was a 51-year-old stand of P. strobus which was making excellent growth. The average d.b.h. of the trees was 35 cm. and the volume growth was 25 cu. meters per hectare per year. The stand was thinned last year and about 60 stems removed per hectare of which 40 were infected with blister rust. All stems; sound or diseased sold at a good profit so there was no loss from the rust. Nearest Ribes were 1 kilometer distant, mostly red currants, some gooseberries and probably some black currants.

In the Forst Feldenmoos, property of the village of Boswil, Switzerland, there are about 10 hectares of P. strobus plantations on pure peat. This is the only species that has succeeded on this soil and the trees have grown very well. Plantations 10, 16, and 31-years-old were examined. In the two younger plantations trees with stem lesions of blister rust were rather numerous. The 31-year stand had been recently thinned so no infected trees were noticed but some had been removed in thinning. Average d.b.h. of remaining trees was 17 cm. The nearest known Ribes were 2 kilometers distant, but whether red or black was unknown. Aecia open and spores being distributed (5/25/39).

In the Forst Erdmannlistein, property of the village of Wohlen, near Zurich, is a 76-year-old stand consisting mostly of P. strobus mixed with considerable Fagus silvatica, some P. silvestris and a little Picea excelsa. This was the best P. strobus so far seen in Europe, the trees having a d.b.h. of 24"+, splendid form, and a long clear length having pruned naturally. Saw one tree with blister rust lesion high on bole but the tree will be cut long before it is finally girdled. Other infected trees have been removed in thinnings but at a good profit. The annual increment for the stand as a whole was 14 cu. meters per hectare in 1937 and for the P. strobus alone was 9 cu. meters per hectare.

At the time these P. strobus stands in Switzerland were examined (5/25/39) there had been light to heavy rains and cloudy weather for over two weeks, aecia were fully developed and discharging spores, and the Ribes leaves were quite well developed but still tender, - ideal conditions for infection.

Throughout Switzerland all species of currants and gooseberries including Ribes sanguineum are widespread in gardens, while two wild species R. petraeum and R. alpinum are generally distributed. These two species are susceptible and dangerous to pines making the problem of control a more difficult one (Gäumann).

According to Burger and Badoux, P. strobus is an extremely valuable species for Switzerland because it yields a soft wood of a quality not duplicated by any other conifer they can grow. Its

complete elimination would be a real calamity. Consequently planting of it is being continued but only in the interior of forest areas as far away from Ribes as possible. It would require a plebiscite in Switzerland to consider a law to eradicate Ribes from areas for pine growing and such a proposal would undoubtedly be defeated.

Near the tennis courts of the Hotel Baer, Grindelwald, Switzerland (el. 3500 ft.) there were 3 large P. strobus (70' + high, open grown, limby) and 3 smaller P. cembra. The former were severely infected with blister rust, lesions with aecial pustules being abundant on the branches but no infections were seen on the P. cembra. Red currant bushes are common in the gardens of Grindenwald; there are also some whites, and a few blacks. Formerly black currant bushes were abundant, but the fruit has been losing favor.

In the forst Ochsenhausen in Württemberg a mixed stand of P. strobus, P. silvestris, P. taxifolia (mountain form) and P. excelsa was established by planting 40 years ago and also L. leptolepis was included in the mixture. The white pine has entirely disappeared having been killed by blister rust. Cultivated Ribes, including R. nigrum, are within a distance of 1/2 - 1 kilometer.

In a discussion with Wolpert who assisted Tubeuf in the latter's studies of the susceptibility of Ribes, he stated that infection is heavy on a few varieties of red currants, but on most varieties it is very light or negligible. See long paper by Tubeuf in Zeitschrift fur Pflanzenkrankheiten 43:433-471, listing the susceptibility of all varieties. In those varieties which are very lightly or negligibly infected the telia are associated with necrotic spots. The currants usually drop their leaves in midsummer because of heavy infection by Gloeosporium ribis. New leaves are then produced not later than September but these leaves are never as heavily infected as the leaves first produced during a season.

In a discussion of blister rust with Tubeuf and Münch, the situation at Trippstadt where the location of the Ribes apparently could not account for the amount of pine infection, was brought up by Münch. Tubeuf stated positively that similar situations had been called to his attention, but that when he made a systematic search he always found the Ribes to account for the infection, well hidden nearby in the grass or other vegetation or he found that Ribes had been present and had been removed for some reason.

Many old trees of Pinus strobus in Sweden which remained free from blister rust for years now have many branch infections although the trunks are not yet invaded. In the northern part of

the Island of Oland there is a fine stand of planted P. strobus about 60 years old. There is plenty of R. nigrum nearby and the island is only five miles or so from the mainland. However C. ribicola has never been found on either the pines or black currants. Red currants are only lightly infected in Sweden and are not dangerous to pines (Lagerberg).

DASYSCYPHA SPP.

At Eberswalde, Germany, saw cankers caused by Dasyscypha on the main stems of 3 small, suppressed Pinus silvestris. The cankers appeared much like those caused by Dasyscypha on suppressed Pseudotsuga taxifolia in California.

Also longer cankers, rather flat and still covered by the bark on main stem of a small, suppressed Abies pectinata. Two cankers on one tree. Cankers looked much like those caused by Aleurodiscus on Abies in the United States. Apothecia present on both Scotch pine and silver fir cankers but could not collect any because they were being studied.

Dasyscypha calycina (?) or abietis (?) has ruined a 12-year-old plantation of Pinus banksiana in southern Sweden. It caused flattened cankers on the main stem and in many instances the stem was finally completely girdled (Lagerberg). Saw the specimens in Lagerberg's collection. According to Lagerberg the cankers were found and the girdling occurred on the main stem just above ground level.

In Lagerberg's laboratory in Stockholm in addition to larch canker caused by D. willkommii, the following Dasyscypha cankers from Sweden were on exhibit: on Pinus silvestris caused by D. abietis Karst.; on P. silvestris ? caused by D. fuscosanguinea; on P. laricie var. austriaca caused by D. abietis; on P. banksiana caused by D. abietis, the cankers being of the flattened type with the bark remaining appressed to the stem (see preceding paragraph); and on Picea excelsa caused by D. resinaria. Cooke.

DASYSCYPHA WILLKOMMII

At Eberswalde, Germany, saw a few Larix europea poles with cankers on the trunk.

According to Liese it has been shown by Münch that the incidence of larch canker is dependent on the races of Larix europea. Provenances from the Alps (Tyrol) are very susceptible to canker because the trees there are less frost resistant, since the season when frosts occur is relatively short and the frosts not severe. Sudeten larch which is resistant to canker is also very frost hardy, because this race is native where the season for frosts is

long and the frosts severe.

In the Forst Freising, Freising near Munich (el. 1700 ft.) saw the larch disease of L. europaea just as described by Münch. Cankers on the main stem and branches, branches dying from bottom of crown upwards with some adventitious shoots which in turn die, and places on bark killed by frost were heavily colonized by lichens.

In the Forst Proskau, Proskau near Oppeln (el. 600 ft.), Larix europaea is of the Sudeten race. It was originally planted and sown here many years ago but is now largely reproduced naturally. The best trees are held for the seed which commands a very high price to commercial seedmen. The larch is not native here although it occurs naturally in the mountains about 50 kilometers to the south. It is always grown in mixture with P. excelsa and P. silvestris, both of which are native. Also A. pectinata is native but little grown because of lack of demand by timber merchants and pulp mills. The larch, spruce and fir are largely naturally regenerated, while the pine is mostly planted.

The mixed stands examined ranged from 20 - 30 to 150 years old. The old larches were of fine form, good clear length, free from canker, and up to 160 feet in height. Among the saplings an occasional tree had a canker on the trunk in the first 2—4 feet above ground level but such trees are removed in thinnings, so that the final stand is canker free. On an occasional sapling a small canker was found which was being quickly overgrown.

In Forst Schelitz (adjoining Forst Proskau), Schelitz bei Oppeln, Ober Schlesien, there was a 130-year-old mixed stand of L. europaea, P. silvestris, and P. excelsa, which with the addition of oak is the usual mixture in Ober Schlesien. All native except larch, which is native in the mountains 50 kilometers to the south. All species now reproduced naturally. This Sudeten larch was 40 meters high, long clear length, straight, and little taper. No lichens except on a few dead lower branches. Only an occasional canker found on saplings. These infected trees are removed during thinning leaving the crop trees absolutely canker free. Not far away on a soil which was too wet for larch, the trees were growing poorly and lichens were abundant on the branches although cankers were rare.

In the Forst Landskron, Landskron Bez. Troppan, Nordmähren (Sudetenland) el. 1800-3000 ft., rough topography, precipitation 600-900 mm. annually, soil dry to moist, much of it with underlying shale, the forest still retains its original mixed composition of P. excelsa, L. europaea (Sudeten race), A. pectinata, P. silvestris and F. silvatica. All these species are native and grow well, particularly spruce, larch, and fir. Natural reproduction is superb and no planting is done except to fill in occasional failed spots.

Larch in mixture ranges from seedling stands to those 100-120 years old, almost invariably even-aged. Trees 80-100 years old range from 12-22 in. d.b.h. and 85-100 ft. high, while those 100-120 years old were 115 feet high. Long clear length and little taper. The finest larch I have seen anywhere. Not a single canker seen and according to Hausser, D. willkommii has never been reported here.

According to Heske, in the former Austrian section of the Alps now owned by Italy where Larix europaea (Alpine or Tyrolean form) is native it can readily be seen from a high point that larch occurs on the upper slopes and ridges, while spruce occupies the lower slopes and valley bottoms, where there is less sunshine, less air and more moisture. Although larch may seed into the valley nearly all the trees die before attaining any size. Locality may thus influence thrift as well as composition.

Also Heske stated that Sudeten larch is not immune to canker, so that in moist localities it can become cankered.

In the Forst Richthof, a private forest of Graf Gurtz - Schlitz about 25 kilometers south of Bad Hersfeld near Kassel, there are some very fine stands of Larix europaea, the finest known in Germany (outside of Sudetenland). The provenance of the seed is unknown and it is controversial as to whether this is Alpine or Sudeten larch. The larch is not native here, the nearest native larch being 300-500 kilometers distant. The soil is good, the topography slightly rough, annual precipitation 630 mm., and the elevation is from 900-1200 feet. The oldest larches are now 142 years old and naturally reproduced, but the ancestors of these trees which were planted have all been cut. The larch is now largely naturally reproduced and occurs mixed with P. silvestris with an understory of beech either planted or naturally reproduced which is for the purpose of maintaining soil fertility and not for wood production. The larch is of fine form, straight, long clear length and grows rapidly. In a stand 110 years old the trees are from 35-45 meters high. Saw one tree in this stand 46 meters high, 5 cu. meters in volume, and 110 years old. Several stands of 100-110 years old were examined and not a single canker was seen. According to the Forstmeister in charge no cankers are to be found in the older stands because the few infected trees are removed when they are young. In an 18-year-old stand of natural reproduction mixed with beech not a single cankered tree was found.

In a 21-year-old stand originally mixed with spruce, the larch suppressed the spruce so the latter was removed. When Plassman was investigating D. willkommii he thought that most infections on the main stem entered through dead branches so at the age of 12 years all the dead and dying branches were pruned in a plot in this stand. When examined in April 1939, trunk cankers

were common over the pruned portion of the main stems on trees in the plot, while cankers were few on adjacent unpruned check trees.

Rohde holds that D. willkommii causing larch canker is a distinct species from D. calycina which always occurs as a saprophyte on the dead branches of L. europaea, L. leptolepis, Pseudotsuga taxifolia and other conifers.

Larch canker is of no consequence or almost entirely absent in Switzerland when larch is grown at higher elevations where there is good air circulation and drier conditions, but canker is extremely severe in stands at lower elevations, that is on the lower slopes and in the valleys where air circulation is poor and dampness is prevalent (Burger).

As a general rule larch canker is rare in Switzerland at the higher elevations where larch occurs naturally but there are exceptions to this rule (Gäumann). At La Fouly, elevation 1600 meters in the Chamonix and Mt. Blanc region there is a very heavily infected stand. A letter from the forester in charge however, stated that the canker was first noticed in the stand in October 1938, following a severe and unseasonable cold period in spring of the same year.

Larix europaea is not native in any part of Sweden. Wherever the tree has been planted it is severely affected by canker caused by D. willkommii, the Sudeten larch being just as susceptible as the Tyrolean or Alpine (Lagerberg).

See also notes on Larix leptolepis.

DAUERWALD

In Barenthorn, the forest of Von Kalitzsche near Zerbst in Anhalt, the Dauerwald method was developed. The forest was visited with Forstassessor Bier and he explained the details.

The forest comprises 3000 hectares on a perfectly level plain, and the annual precipitation is about 700 mm. Pinus silvestris is native but the original stand was largely hardwoods. Then the forest was converted to practically pure Scotch pine, although now hardwoods are being worked into the pine as an understory, largely by planting, Q. robur and F. silvatica mostly being used. A little P. excelsa for the deer (Reh).

The old silvicultural method here was the usual one for Scotch pine throughout Germany; pure evenaged stands, clear cut and replant. Planting costs from 300 to 600 RM per hectare depending on the amount of soil preparation needed. This results in trees which grow rapidly at first until the stand closes giving broad

growth rings in the center of the tree the wood of which is low in technical quality. In addition the branches are long and relatively thick. After the stand closes the growth slows down markedly and the crowns become small. Also the stand is rather dense, i.e. a large number of stems are maintained per hectare until the final cut. Clear cutting often resulted in poor soil conditions at Barenthoren, as it still sometimes does in the other pine forests in the vicinity and elsewhere in Germany.

About 60 years ago the Dauerwald method was evolved by Von Kalitzsch. It is merely selection cutting. However trees are removed from the entire 3000 hectares of the forest every year, and an unevenaged forest results in which the soil is never completely exposed. Reproduction is natural, eliminating the high planting cost. There are fewer stems per acre than in the evenaged, planted stands and the volume per acre is somewhat less, on the other hand the individual trees are larger, the quality of the wood is much better thus commanding a considerably higher price and the growth per cent is much greater. This last is because there are fewer stems per acre enabling the trees to have larger crowns and thus to have much better growth when they are old, i.e. 50 - 90 years.

Natural reproduction is depended upon entirely and as the young trees develop under the old stand, they have narrower rings and much smaller branches than planted trees. This results in stems of approximately uniform ring thickness throughout and with very small knots. All slash from cutting is left on the ground to enrich the soil except that the larger branches are utilized for firewood.

Although Trametes pini and Peridermium pini were at one time fairly common in this forest, they are now comparatively rare because infected trees are removed yearly as found.

In the spring and early summer of 1939 there was a heavy attack by the Nonne (Lymantria monacha) on the pine in the even-aged state forests surrounding Barenthoren. The damage was the worst in many years and the epidemic was finally controlled by airplane dusting with arsenicals. There was some damage to the pine stands in Barenthoren immediately adjacent to the even-aged state forests, but in the interior of the forest the infection was light and the damage insignificant or none. All Barenthoren pine stands are unevenaged.

EARTH RAYS (ERDSTRAHLEN)

In German periodicals during the past eight years there have been numerous papers discussing the relation of radioactivity of the soil to plant diseases. These relatively localized areas

where radioactivity is presumed to occur are determined by means of a divining rod (water witch). It has been postulated by some writers that the so-called earth rays (Erdstrahlen) emanating from the soil of such areas have an unfavorable effect on the growth of plants, either directly causing disease or making the plants more susceptible to disease caused by other agents. K. M. Müller has written several papers stressing the importance of earth rays in causing tree diseases, but the opinion of European pathologists is almost unanimous that there is no sound basis for this hypothesis.

Müller came to Holland and took a number of botanists into the field to demonstrate the hypothesis. However not one of the botanists was convinced. Van Vloten thinks that there is no relation between earth rays and disease although he did not accompany the party.

Dr. Wartenberg has given careful consideration to earth rays and concludes that they have no relation to plant diseases. This he has fully discussed in a published paper with an extensive bibliography. (Wartenberg, Hans. Wünschelrute, Erdstrahlen und Pflanzenkrankheiten. Nachrichtenblatt für den Deutschen Pflanzenschutzdienst Nr. 11 u. 12. 1937). For the divining rod (Wünschelrute) used to detect areas where earth rays occur, Wartenberg stated that a sausage would be as satisfactory as any of the apparatus used.

No scientific basis for considering that earth rays cause plant diseases (Liese and Zimmerman).

Earth rays are merely a superstition. Have no relation to disease (Münch).

EXOTIC TREES - MISCELLANEOUS

Quercus rubra is much in favor in northern Germany. Often planted under Pinus silvestris.

In Forst Freisenwalde near Eberswalde there is a small but fine 45-year-old plantation of Abies grandis which has made excellent growth and is free from insects or disease.

Around Bad Berka where there are extensive stands of Picea excelsa de Marées does not favor such an extensive use of the tree because it is not native so that it often does not do well because of site conditions. However it is not easy to select suitable sites for an exotic. P. silvestris on the other hand, which is native, has been much easier to handle.

The introduction of exotics and the extension of the range of a native tree is risky, owing to difficulties in site selection

and attacks by parasites. Both should be avoided if possible, - use native species (Heske).

Quercus rubra and possibly Larix leptolepis are the only two exotics in Germany that have so far proven an unqualified success. No disease or insects attack either and they grow very well (Franke). L. leptolepis - drought! (JSB.?

Picea excelsa is a mountain tree and much difficulty is encountered in moving it to lower elevations where it is attacked by insects, which are favored by the warmer climate (Franke).

There was a 9-year-old stand of Pinus contorta in the Forst Tharandt. Trees have grown fairly well so far.

In the Forst Ravensburg there was a stand of Larix leptolepis of pole size covering an acre or two. The trees had grown rapidly and were of fine form. However this species is susceptible to drought and during the dry summer of 1934 was considerably damaged in various places in Germany.

Apparently exotics in most instances will need an approximation of the care given to agricultural crops to bring them through successfully. This can be given to some extent in Europe where timber is so valuable but not in the United States.

In the Exotengarten at Weinheim near Heidelberg is a 70-year-old stand of Sequoia gigantea covering 2 hectares. Trees are of fine form and excellent growth. No loss from insects or disease. Climate mild (Heidelberg is one of the warmest places in Germany, with an early spring) and rainfall about 670 mm. annually.

In the same garden there are a few Abies concolor, 70 years old and over 150 feet high.

It is Helbling's opinion that it is inadvisable to grow exotics in Switzerland, there have been too many failures in the past. Better concentrate on native species.

Gäumann thinks that as a general principle it is far better to concentrate on selecting and developing the best strains of the trees native to Switzerland than it is to cultivate exotics. Burger and Badoux think that exotics are generally disappointing but are anxious to continue with Pinus strobus.

In my opinion the great mistake with exotics has been to accept early promise as a guarantee for the future and then plant extensively. Should be planted for a long time on an experimental basis, on various sites, in various regions, and the origin of

the seed must be known exactly.

See also notes under Larix leptolepis.

Exotics have not been successful in Sweden and are now little used. Of fourse planting of exotics was never as extensive in Sweden as in Germany and adjacent countries. Something always happens to an exotic. For example Pinus nigra in southern Sweden was so badly damaged by Brunchorstia destruens as to be worthless (Lagerberg). Also see notes on Pinus banksiana under Dasyscypha spp. and on Larix europea under D. willkommii.

FOMES ANNOSUS

A possible reason for the lack of damage by F. annosus to young trees in plantations in the United States (it kills planted trees 3-4 years old quite often in Holland), is because in the old fields where so much planting is done there is no substratum available for the fungus at first. This must be created by the new stand (pruned and broken branches, death by suppression, leaving dead roots, etc.) so that it is 20-25 years or more before the fungus is sufficiently established to infect and damage the trees (Van Vloten).

Van Vloten has found that the only way to inoculate successfully with F. annosus is to bury a large piece of infected wood, preferably from the root or butt of a naturally infected tree, in a flower pot with a growing conifer and await developments. Results may come in a few months or several years.

F. annosus rot in butts of a few felled 30-year-old Pinus strobus and conks on a few stumps from felling several years ago. Of 5 Picea sitchensis 30 years old that had been felled, 4 had butt rot. P. excelsa is unsatisfactory in this forest because it is so susceptible to this butt rot. An occasional 30-40-year-old Pinus silvestris also infected. (Koninklyk Royal Park, Apeldoorn, Holland).

In a 15-year-old plantation of Pseudotsuga taxifolia several trees had been killed, and on one living though declining tree there was a sporophore on the main stem just at ground level. On a large stump of P. taxifolia nearby there were several sporophores.

On the several forests in the vicinity of Bad Berka near Weimar, Germany, there are extensive stands of Picea excelsa either pure or in mixture with other conifers or with beech. Root and butt rot caused by F. annosus is prevalent the decayed wood having exactly the same appearance as that in spruce in the United States. The incidence of decay is considerably greater in pure than in the

mixed stands, but the Forstmeister said he did not see a relation between decay and any other factor. De Marées does not favor P. excelsa around Bad Berka because the species is not native to the region, but he strongly favors Pinus silvestris which is native. If an exotic is to be used to any extent he would prefer Pseudotsuga taxifolia which attains a much greater size at the same age than P. excelsa.

F. annosus in Germany is damaging only to planted stands but is of no consequence in naturally regenerated stands. It is most severe in planted stands of Picea excelsa on rich soils, particularly agricultural soils, because they contain much nitrogenous material which favors the fungus. Other decays of spruce entering through wounds caused by wild (deer) and other agencies are more severe on the poorer sites (Münch).

In the Forst Freising, Freising near Munich there are stands of A. pectinata from 35-70 years old naturally reproduced with the failed spots filled in by planting. The tree is native here. F. annosus rarely causes butt rot of this species, but in adjoining stands of P. excelsa, which is also native but with the stands reproduced by planting, butt rot is heavy.

In Forst Tharandt (el. 400 meters) there is some butt rot caused by F. annosus in Picea excelsa. Not severe as in other forests seen.

In Forst Proskau (el. 600 ft.), Proskau near Oppeln, where P. excelsa is native and largely naturally reproduced there is little F. annosus as shown by an examination of a number of felled trees. Also P. excelsa is rarely grown pure but in mixture with L. europaea and P. silvestris.

In Ober-Schlesien where Picea excelsa is native and commonly reproduced naturally loss through butt rot by F. annosus is generally slight.

In Staatsforst Landskron (see description under D. willkommii), where P. excelsa is native, naturally reproduced, in mixture and in its optimum there is very little cull from rot caused by F. annosus, even in stands 80-100 years old.

On P. excelsa according to Hausser, butt rot by F. annosus is most severe on very good soils where the spruce grows rapidly and has light, broad-ringed wood which is rapidly decayed once it is infected. The spruce on poorer soils is less decayed because the wood is slower grown and heavier, consequently not so easily decayed. (This depends on not leaving even the slower growing spruce too long after it has passed the age at which decay can become serious. JSB).

In the Forst Langenbrand (northern Schwarzwald) where A. pectinata and P. excelsa are both native and reproduction is natural, there is almost no Fomes annosus on the fir and very little on the spruce.

In the Forst Kaiserslautern (Bayer. Pfalz) an experimental plantation of Picea sitchensis was established in 1912. The trees grew well at first but then a dry year came and subsequently there were many trees killed by Fomes annosus. Too dry here for this tree (Münch).

At Grindelwald, Switzerland, elevation 3700 ft., a pure, unevenaged, naturally reproduced stand of Picea excelsa was examined. The stand was typical of those at higher elevations in the Alps. The oldest trees were about 80 years old and the stand was being cut on the selection system. The trees had grown slowly and were not of high quality, but they were relatively free from disease. There was only a little butt rot caused by F. annosus.

In Switzerland Fomes annosus causes more butt rot in pure stands of Picea excelsa than in mixed, and more in planted than in naturally reproduced stands. This butt rot is particularly had in stands of the first generation following agricultural crops because such agricultural soils are rich in nitrogen which is particularly favorable to F. annosus (Gäumann).

See paper by Hopffgarten in Phytopath. Ztschr. 6(1):1 - 48 (1933) for explanation of this nitrogen relation.

See also notes on Japanese larch.

On exhibit in Ferdinandsen's laboratory in Copenhagen is a butt cross section of Sequoia gigantea 16 inches d.i.b. with a central core of decayed heartwood 7 inches in diameter caused by Fomes annosus. The specimen was collected in Denmark.

FOMES FOMENTARIUS

In Holland, Fomes fomentarius is known only as a saprophyte on various hardwoods. It does not occur on living trees (Van Vloten).

In Germany the fungus is usually saprophytic on various hardwoods, but occasionally it is actively parasitic on Fagus silvatica, killing the cambium in long vertical streaks, which results in ridges developing between the dead areas. This is known as Rinnigkeit (Liese).

In Germany the fungus is almost invariably saprophytic on various hardwoods, but particularly on Fagus silvatica. It was

occasional in Germany until after the very cold winter of 1928/29 when so much injury occurred to hardwoods especially beech. Then F. fomentarius became quite abundant, particularly on beech. Although Rinnigkeit is presumably caused by this fungus, it has not been definitely proven and it is possible that F. fomentarius merely follows after streaks of the cambium and sapwood have been killed by cold or some other agency (Münch).

In Switzerland the fungus is practically unknown (Gäumann).

In Sweden this fungus commonly causes heartrot of living hardwoods, particularly Fagus silvatica. It is also a common saprophyte (Lagerberg).

FOMES IGNIARIUS

Just outside Eberswalde there was a large Quercus rubra (borealis) with the same type of canker on the trunk as described by Münch (Naturw. Ztschr. f. Land - u. Forstw. 13:509-522) on Quercus robur caused by Fomes igniarius. There were several fructifications on the bark of the canker at the center which Zimmerman said were F. igniarius but to me they looked more like F. robustus, with a vivid red-brown undersurface and a smoother upper surface than I have usually seen on F. igniarius. According to Liese, F. igniarius is rare on Quercus in Germany while F. robustus is common, but the two fungi are very difficult to separate, even in culture so their relative prevalence may be confused. This canker looked somewhat like the cankers on oaks in the United States caused by Polyporus hispidus. This fungus is not found in Germany.

These lesions on oak are not true cankers as defined by Westerdijk and Appel, in which there is a ring of callus developed yearly which in turn is killed by the parasite. Only a few of the lesions commonly termed cankers are true cankers according to this definition, i.e., larch canker caused by Dasyscypha willkommii and Nectria canker caused by Nectria galligena. Annual cankers such as are caused by Phomopsis pseudotsugae could be called bark anthracnoses.

Saw some cross sections through cankers caused by F. igniarius on oak at the Forstbotanisches Institut at München. As pointed out by Münch, the callus is not killed back yearly by the fungus but grows for several years before it is killed again.

FOMES PINI

Common on Pinus silvestris around Eberswalde, Germany, with swollen knots the same as on Douglas fir on the Pacific Coast although not so prominent. Undersurface of conks daedaloid as on Pinus ponderosa or Pseudotsuga taxifolia.

Occasional on Pseudotsuga taxifolia at Eberswalde. Saw conks on the trunk of a 54-year-old suppressed tree.

In the Forst Bad Berka there is a 110-year-old stand of Pinus silvestris severely infected with F. pini with both conks and swollen knots abundant. According to De Marées, decay becomes significant at about 80 years in the life of the stand. Some stands are severely damaged, others are practically free from infection but there seems to be no apparent reason for the difference.

This fungus is rare in southern Germany even on P. silvestris according to Munch. However it is very abundant in northern Germany and Von Schroeder explains this by the fact that P. silvestris is the prevailing tree in the north so that the fungus has a tremendous substratum, - extensive areas of Pure P. silvestris.

In the Forst Schelitz, Schelitz bei Oppeln, Ober Schlesien, in a 140-year-old stand of P. strobus two trees were seen with conks of F. pini. One of them had several swollen knots, in appearance much like those on P. taxifolia in the U.S. According to Forstmeister Müller, 35 - 40% of the P. silvestris trees in this forest are infected. First infections occur when heartwood formation begins (40 - 55 years; late here) but cull is not serious until 80 years.

Fomes pini, once fairly prevalent in Barenthoren on Pinus silvestris where the Dauerwald method is practised, is now relatively rare because for about 60 years infected trees have been removed yearly as found.

FUNGI - MISCELLANEOUS

Rhizosphaera (kalkhoffii ?) saprophytic on needles of Picea pungens. Eberswalde, Germany. March, 1939.

Lentinus lepideus (squamosus) causing rot in the butts of two 40-year-old trees of Picea sitchensis. Eberswalde.

Melampsorella caryophyllacearum causing cankers on the trunks of a 77-year stand of A. pectinata. Cankers on a few trees (5% at most); all cankers at 30-50 ft. on trunk. (Forst Freising, Freising, near Munich; el. 1700 ft., April 1, 1939). Tree is native.

M. caryophyllacearum rarely causing cankers on the trunks of A. pectinata. Tree native and vigorous here. Staatsforst Landskron. See description under D. willkommii.

Hypodermella nervisequia on A. pectinata, light infection and no damage. Tree native and vigorous here. Staatsforst Landskron.

Lophodermium macrosporum on Picea excelsa was seen in Forst Hersfeld (Bad Hersfeld, Bez. Kassel, 4/20/39) but was not damaging. According to Liese, Münch and Rohde this fungus although found commonly enough in Germany is not sufficiently severe to be economically injurious. The same is true for Hypodermella nervisequia. Hartig apparently exaggerated the effect of these fungi or confused them with something else. For example such severe defoliation of P. excelsa attributed to L. macrosporum has occurred in the more moist localities of Denmark that this spruce can scarcely be grown, but Rohde states that he has seen this spruce disease in Schleswig Holstein and he is convinced that it is not caused by L. macrosporum. May not be a fungus disease but non-infectious.

In Forst Langenbrand (northern Schwarzwald) where A. pectinata is native and very fine there were a few saplings and small poles with trunk galls caused by Melampsorella caryophyllacearum. These infected trees are removed in the earlier thinnings leaving the final crop trees sound.

In Stadtforst Raperswil, Switzerland a few Abies pectinata poles had trunk galls caused by M. caryophyllacearum.

According to Badoux, Chrysomyxa abietis which occurs from the lower to the higher elevations and C. rhododendri which is more commonly at higher elevations occasionally become epidemic in Switzerland, causing alarm out of all proportion to the slight damage resulting. Such an epidemic of C. rhododendri occurred in the summer of 1938.

Taphrina alni-incanae occasional on Alnus glutinosa in the alder stands in the river bottom at Grindelwald, Switzerland, el. 3500 ft. (6/5/39).

Polyporus betulinus frequently causes heartrot of living Betula verrucosa (alba) in Sweden. Of course it is most abundant as a saprophyte (Lagerberg).

Witches brooms on Betula verrucosa caused by Taphrina betulina were common where this tree occurred in Sweden, Denmark, Germany and Switzerland. It was quite prevalent in the vicinity of Warnemunde on the Baltic in Mecklenberg.

Brunchorstia destruens causes a prevalent dieback of the shoots of Pinus nigra in Holland (Van Vloten).

Crumenula pinicola on Pinus silvestris was seen in the laboratory of Van Vloten. The cankers were quite similar in appearance to those on hard pines in the eastern United States caused by Atropellis except that there was no blue stain, only browning of the wood underlying the canker.

HOLLAND

During the course of a drive from Wageningen to Apeldoorn and return by a different route extensive plantations of Scotch pine were seen. This is the conifer most extensively planted in Holland. Larix europaea has been given up because of canker but L. leptolepis is finding some favor. Pseudotsuga taxifolia is now replacing Scotch pine in the opinion of many because of its much more rapid growth. The coast form is best suited to Holland although unfortunately a number of plantations of the mountain forms have been established. At present P. taxifolia ranks second to P. silvestris in the amount planted. Picea sitchensis has been planted but little so far.

INCREMENT BORINGS - DECAY

Liese states that he has no knowledge of decay originating from holes made by increment borers in either hardwoods or conifers in Germany. However it is the universal practice to plug the holes immediately with hardwood plugs; any hardwood will do, but beech (Fagus silvatica) is most commonly used. The plugs, which are marketed in packages by the manufacturers, are impregnated at the factory with natrium (sodium) fluorate (Na F). This preservative is the principal constituent of Wolmann salts.

According to the experience of De Marées there is no danger of decay entering through increment borer holes in Pinus silvestris or Larix europaea even though the holes are left unplugged, but Picea excelsa is quite liable to decay unless the holes are plugged. Any hardwood, but particularly Fagus silvatica, is liable to infection when bored if the holes are not plugged. However the chances of infection in any conifer or hardwood is remote if the hole is plugged.

Incipient decay (discoloration) will appear around increment borer holes in P. excelsa within one year if holes are not plugged. In beech decay will also appear around unplugged holes in slow growing (suppressed) trees, but not in fast growing, vigorous trees. If holes are plugged air-tight, there is practically no chance of decay (Münch).

Increment borings are made in Switzerland now largely to determine whether or not stems are decayed. Holes must be plugged as a precautionary measure, although there has been no actual experience with decay entering through holes made by borings. The increment borer is rarely used for growth determination, since all the Swiss forests are remeasured every 10 years. Some of the more valuable stands are remeasured every 6 - 7 years, while others in the high Alps are remeasured every 15 years (Burger).

There is no danger of decay entering through increment borer.

holes if these are plugged and this is no problem in Switzerland since the increment borer is little used (Gäumann).

LARIX LEPTOLEPIS

In the Forst Ravensburg in Württemberg there was a stand of pole size covering an acre or two. The trees had grown rapidly and were of fine form. However this species is susceptible to drought and during the dry summer of 1934 was considerably damaged at various places in Germany.

The most extensive and successful plantations of L. leptolepis are in the Forst Ochsenhausen in Württemberg, which lies at an elevation of about 1900 feet on rolling land. Here it was necessary to find a species that could be grown in mixture with Picea excelsa and that would let some sunlight through to the soil, which is very heavy, hard, wet in places and quickly develops raw humus with pure spruce. Spruce was native here, but only in a limited quantity and not pure. Formerly the land was largely occupied by hardwoods, - beech, birch, oak, and white beech (Carpinus). These hardwoods are now always mixed with Japanese larch and spruce in plantations, in order to improve the soil and little timber is anticipated from the hardwoods. Japanese larch has so far been the perfect conifer to mix with spruce but the larch must not be planted too thickly and some must be removed in early thinnings or the spruce will be completely suppressed. On the other hand it is characteristic of Japanese larch to develop a small percentage of crooked stems, so that allowance must be made for this in planting in order that such trees can be removed in early thinnings.

In northern Germany where there is less precipitation, this species has been injured in dry years such as 1934, but in this forest with an average precipitation of 850 mm. no injury has resulted even in the dry year of 1934.

In the Forst Ochsenhausen, the plantations of Japanese larch are largely in two districts. In the District Wildbuch the first stand examined was a 40-year-old mixture of L. leptolepis, P. excelsa, P. silvestris, P. taxifolia (mountain form) and P. strobus. Only Japanese larch and spruce remained, the former being 80 feet high and with an average d.b.h. of 24.3 cm., while the latter were only 10-15 ft. high because of suppression. The Scotch pine and Douglas fir were so severely suppressed that they disappeared some years ago, while the white pine was all killed by blister rust, currants including R. nigrum being only 1/2 - 1 kilometer distant in farm gardens. Some of the young larches were killed by Armillaria mellea, but not sufficient to affect the productive capacity of the stand significantly, and a few of the present trees have butt rot caused by Fomes annosus. No Dasyscypha willkommii has ever been found on this tree, although the fungus occurs here, because Larix

europaea was so badly affected by canker and dying of branches (larch) disease - Münch), that it was given up and is no longer planted.

The other stands examined were in the District Simmisweiler. First saw a 42-year-old stand of even better from and somewhat taller than the above 40-year-old stand. Average d.b.h. 28.3 cm. No canker and no larch disease (i.e. dying of branches with abundant development of lichens from base of crown upwards). Immediately adjacent were the remnants of a stand of L. europaea of the same age, only a few trees remaining with cankers abundant on the trunk and dead and dying branches covered with lichens.

However not far away were a few 80-90 year old European larches of splendid form and fine growth, - 100+ ft. high and 18-28" d.b.h.; long clear length. All the trees were free from canker except one with several trunk cankers healed over. All succeeding European larch stands planted on this forest have failed but seed has not been used from these old trees because of the difficulty of collecting it. Consequently this may be a different race or it may be the lucky survivors of a dense plantation. Nothing is known of the origin of the seed from which these old trees were produced, but this certainly shows the value of always being certain of the source of seed and keeping adequate records.

Next was a 40- to 48-year-old mixed stand of Japanese larch, spruce, oak (Q. robur), and beech (F. silvatica). The larch had made fine growth, but quite a few had crooked stems and should have been removed early.

Last were two stands both 28 years old; one of pure Picea excelsa and the other of L. leptolepis and P. excelsa mixed. The two stands were planted on the same soil originally, on level ground and were side by side. In the pure stand the spruce was of poor form, and it had grown slowly, the ground was covered deeply with Polystichum and mosses and there was much raw humus. In the mixed stand, the spruce had made much better growth and the larch had grown exceedingly well. There were no plants of any kind on the ground, there was no raw humus and the soil was an excellent brown mull. The two stands were only 5 feet apart, planted the same year, level ground, and the soil was the same to begin with, i.e., poor. The only difference was the presence of Japanese larch.

Also as part of the same experiment L. europaea had been mixed with P. excelsa but the larch had mostly disappeared because of the "larch disease". The few remaining larches had cankers on the trunk and the branches were dying from the larch disease, - from base of crown up. Many lichens on branches. Growth of spruce and condition of soil same as in pure spruce stand.

LOPHODERMIUM PINASTRI

At Eberswalde various fungicides are being tested to control Lophodermium pinastri on Pinus silvestris in the nursery. One-year-old seedlings are commonly killed by this fungus but 2-year- and older seedlings are rarely killed. It is of no consequence on trees of sapling size and larger (Liese).

In the Forst Langenbrand (northern Schwarzwald) this fungus occurs commonly on P. silvestris saplings but is not significantly damaging.

On Pinus silvestris seedlings and saplings in Bavaria, Baden and Württemberg, L. pinastri is relatively common but rarely significantly injurious.

NATURAL REGENERATION OF EXOTIC TREES

In Koninklyk Royal Park (near Apeldoorn, Holland) was seen abundant and very fine natural regeneration of Pinus strobus from old trees planted many years ago. The reproduction occurred both under these mother trees and also under very open and old Pinus silvestris, showing the perfect adaptation of P. strobus to the shelterwood system in Europe. The reproduction, ranging from seedlings to large saplings was as fine as any ever seen in New England.

In Willems Bos near Nunspeet, Holland there is a natural reproduction of Pinus strobus. Also a little natural reproduction of Chamaecyparis lawsoniana, some of Pinus nigra, very abundant of Pinus silvestris, a little of Abies grandis and a little of Pseudotsuga taxifolia.

See also notes under Cronartium ribicola.

NECTRIA

According to Wollenweber, Nectria coccinea in Europe is invariably a saprophyte except one variety which has been found parasitic, causing cankers on poplars in Holland. N. ditissima and N. galligena both cause cankers on the same broad-leaf hosts and can be distinguished only microscopically by a decided difference in the size of the ascospores. The two cannot be separated by the type of canker caused. N. ditissima causes small cankers on Fagus silvatica which become overgrown by callous tissue making a large gall or tumor on small to large branches or even on the main trunk. The fungus remains alive in the wood of these swellings around the original canker. Most infections occur through hail wounds. N. ditissima rarely causes the open type of canker on beech. As I saw these swellings on F. silvatica they were similar to the swellings on Betula lenta and Acer saccharum in the northeastern United States which also seem to be caused by Nectria.

In Germany N. ditissima is rarely found on apple but N. galligena is common on apple causing the open type of cankers.

In the Forst Emmendingen near Freiburg a 50-year-old naturally reproduced stand of hardwoods was composed of 85% F. silvatica, the remainder being Q. pedunculata, B. alba (verrucosa) and a little L. europaea. The beech had many trunk cankers caused by N. ditissima on the southwest side of the trunks. Infection almost exclusively through hailwounds and the principal storms come from the southwest. Cankers usually not large and mostly overgrown. Cankers begin on young stems with thin bark because when the stems become older and the bark thickens there is no wounding by hail. No Cryptococcus fagi seen.

Nectria canker is apparently common on hardwoods in Sweden judging by the specimens on exhibit in Lagerberg's laboratory and in each instance the causal organism was given as N. ditissima. The following hosts were represented with typical cankers of the target type: Fraxinus excelsior, Quercus sp., Tilia sp., Populus alba, Populus tremula, Pyrus malus and Fagus silvatica.

On exhibit in Ferdinandsen's laboratory in Copenhagen and collected in Denmark were Nectria cankers on all the hardwoods seen in Lagerberg's exhibit in Stockholm and on other hardwood species in addition. In every instance the causal organism was given as Nectria galligena. Target cankers and cankerous galls on Fraxinus excelsior were both labelled as caused by N. galligena.

ORIGIN OF SEED

The origin of seed is of first importance in artificial reforestation, and seed from an improper source explains many failures in Germany and to a lesser extent in Holland. In the majority of artificial stands the seed source is unknown, so that when any difficulty arises in development of the stand there is always considerable doubt as to whether or not the basis of the trouble may not be unsuitable seed rather than the organism which seems to be responsible. The importance of the source of seed has been particularly brought out with Pseudotsuga taxifolia, Pinus silvestris, Larix europaea and Alnus.

In Holland there is an extensive series of sample plots scattered throughout the country to test the provenances of Pseudotsuga taxifolia seed. Plots originally established by the Forest Experiment Station, since discontinued, and are now under the care of the Department of Silviculture of the Landbouwhoogeschool at Wageningen. The series of plots at Stroe (a state forest) and at Speulder Bosch (a state forest) were visited. Striking differences in growth, the best development being made by trees from seed from Chilliwack, B.C., and the poorest by seed from Golden, B. C.

On the whole the mountain forms seem unsuited to Holland, the coast form being much the best. Also marked difference in reaction to fungi and insects (see under Races of Douglas fir).

At Eberswalde, Germany there are sample plots of 28-year-old Pseudotsuga taxifolia from 19 provenances in the western United States. Shoqualmia provenance best of all by far with Pecos provenance best of the mountain forms. (See paper by Liese in Mitt. Deut. Dendrol. Ges. for 1936.) Among the provenances of the mountain forms there were differences in susceptibility to Rhabdocline between provenances and also between individuals within a provenance. The coast forms were not infected.

At Eberswalde there are also sample plots of 30-year-old Pinus silvestris representing different localities. Trees were planted. East Prussia provenance best, Brandenberg next, followed by Riga, Belgian, French, Scottish and Russian provenances in order. The first three provenances have an excellent form, but Riga has grown slower than the other two. The last four provenances are practically useless for this part of Germany, - slow growth, crooked, etc. Some of the trees in the poorer provenances were severely attacked by Cenangium abietis.

In the Forst Freising, Freising near Munich (el. 1700 ft.) saw some alders of the poor Belgian race. These trees grow well for a few years until they attain a height of 8 - 12 ft. and then languish, have poor form, make little height growth and some die. (See Munch in Forstwiss. Centbl. 58:173-194, 230-248).

In Forst Tharandt saw a stand of P. silvestris of very slow growth, poor form and thin crowns. The species does well here so this stand was evidently from French or Belgian seed.

Along the Reichsautobahn from Frankfort A/M to Karlsruhe there are many stands of Pinus silvestris of very poor form, that is with crooked trunks. According to Zimmerle these stands are of a poor race. Liese confirmed this and stated that up to about 1900 or a few years later the principal source of P. silvestris seed for Germany and many other parts of Europe was the firm of Conrad Appel in Darmstadt. This firm bought cones from the region immediately around Darmstadt, most of which were collected from seed trees of this bad race, so that now the name of Appel Kiefer or Darmstadter Kiefer is synonymous with crooked trees. This poor race, which grows quickly, has been largely eliminated from the state forests but still remains in the private forests until the stands attain sufficient size so they can be cut with profit. Consequently the bad trees continue to cross pollinate with good ones. The loss in Germany from this bad race has already been very great and will continue for many more years although steadily lessening.

Excellent examples of these crooked trees may be seen along the Schepp Allee in Darmstadt, near the Bahnhof.

In the Forst Trippstadt (Kaiserslautern, Bayer, Pfalz) there is a series of plantations testing the provenience of P. silvestris seed.

See notes on Pleurotus mitis, Larix leptolepis and Tsuga heterophylla.

PHOMOPSIS PSEUDOTSUGAE

In the Forest of Kootwyk, Kootwyk, Holland, a stand of 35-year-old Pseudotsuga taxifolia was examined. The trees were from 8 to 12 inches diameter breast high and all had been pruned to a height of 16 to 18 feet. There were cankers caused by Phomopsis pseudotsugae on the trunks of a few of the trees within the first 6 feet above ground level, infection having apparently entered through slight wounds made by pruning. This was the coast form of Douglas fir.

In another 40-year-old stand of Pseudotsuga taxifolia (coast form) with the trees ranging from 8 to 14 inches d.b.h. and about 65 feet high, there were a few cankers caused by Phomopsis pseudotsugae on the trunks within the first 8 feet above ground level.

In Koninklyk Royal Park, near Apeldoorn, Holland, there was an 8-year-old plantation of Pseudotsuga taxifolia (coast form), established with 3-year-old seedlings grown from seed collected from older trees in the Park. The trees, from 8 to 10 feet high, were lightly infected with Phomopsis pseudotsugae which was causing death of leaders and branches by dieback, and by cankers girdling the small stems. Some cankers did not develop sufficiently to girdle the main stem.

Phomopsis pseudotsugae also present on the sample plots of Pseudotsuga taxifolia (coast form) at Stroe and at Speulder Bosch, both state forests, in Holland. The mountain forms of this tree were not attacked.

Near Eberswalde, Germany, a 28-year-old stand of Pseudotsuga taxifolia (coast form) was severely attacked by Phomopsis pseudotsugae, with 52.3% of the trees having cankers on the main stem and 47.7% without infection. There were no branch cankers or no dieback in this stand although among some younger trees not far away there was a little dieback. The cankers were of all ages from those just forming this winter to others 10 years or more old. One tree 10 inches d.b.h. had several large cankers 18 inches or more long and 10 inches or more wide completely deforming the main stem.

At Hackerhausen, south of Berlin, there is also a severely infected stand where many trunk cankers have attained a length of 3 feet. Although attack by Phomopsis pseudotsugae may follow frost injury, this does not explain the severity of the attack in the two stands at Eberswalde and at Hackenhausen.

Phomopsis canker is undoubtedly a very old disease in north Germany. It has been present at Eberswalde since 1894 when it was described and figured as caused by Phoma pithya (Böhm, B. Ueber das Absterben von Thuja Menziesii Dougl. u. Pseudotsuga Douglasii Carr. Ztschr. f. Forst u. Jagdw. 28:154-161. 1896). A specimen of canker on Pseudotsuga taxifolia collected by Böhm near Eberswalde in 1894 and labelled Fusicoccum abietinum is in the museum of the Botanisches Institut at Eberswalde. It agrees in every way with the appearance of canker caused by P. pseudotsugae even to the character of the pycnidia on the bark, but these have not yet been studied microscopically.

Zimmerman has been studying the same stand near Eberswalde in which Böhm originally made his investigation of Phomopsis canker. In 1896 the trees were 12 years old and are now (1939) 54 years old. These trees still show the scars of very old Phomopsis cankers and on some of them there are more recent cankers caused by P. pseudotsugae. It is a reasonable certainty that the old cankers were caused by P. pseudotsugae but they should be dissected to ascertain the exact date of formation. Also whether some of the large, healed lesions near the butt were caused by P. pseudotsugae or by deer can only be decided by dissection.

Phomopsis pseudotsugae seen rarely in southern Germany by Münch and then only on Pseudotsuga glauca, the mountain form of Douglas fir (! ? JSB.)

PICEA SITCHENSIS

In Willems Bos, near Nunspect, Holland there was a 40-year-old stand of Picea sitchensis which had made rapid growth and was of fine form. In 1935 some trees began to die because of attack by Fomes annosus and Dendroctonus micans. The damage by the insect increased so rapidly that by February 1938 the stand was reduced from 720 to 75 trees per hectare, the others having been removed or marked for cutting. The damage by the fungus increased relatively little. The usual host for D. micans is Picea excelsa, it having first been found in Holland at Schovenhorst in 1935 on Picea orientalis. However at Willems Bos, P. excelsa is only slightly infested and not damaged. Wiedemann of Eberswalde has found damage to P. sitchensis by the same insect at three localities in Germany; viz. near Frankfurt, near Aachen or Aix-La-Chapelle, and in Schleswig Holstein. Also found it at Het Loo on P. sitchensis but not yet severe.

See notes under Fomes annosus.

PLANTED VS. NATURAL STANDS

In the Forst Buchfarth near Bad Berka there are extensive stands of Fagus silvatica high forest of exceptionally fine quality. The trees are 125-140 feet high with a long clear length. Stands are naturally reproduced by gradual removal of the mature stand over a period of 6-10 years but the stand must not be opened up too suddenly or grass and shrubs will occupy the ground instead of beech reproduction. Forstmeister Peitzsch showed a relatively young stand (trees 20 - 25 ft. high) which was of poor form with many crooked stems and slower growth. This was the only planted beech on the forest and he attributed its inferiority to the fact that it was planted and not naturally reproduced as were the others. Seed came from this forest.

Beech at one time lost somewhat in favor in Germany because the wood was not in demand, but now it is considered a very desirable species because it is valuable to make the wool substitute so much used.

See also notes on Fomes annosus and on soil.

The critical age for plantations in Germany is from 25 to 40 years of age (Franke).

In the Staatsforst Landskron (see description under Dasyscypha willkommii) where larch, spruce, fir and pine are native, in mixture, naturally reproduced and very vigorous, there is no canker on larch, no Dreyfusia nüsslini on fir, and very little butt rot from F. annosus in spruce even when old. 50 kilometers to the north where this Sudeten larch is not native, although it is still growing vigorously and reproducing naturally there is a little canker.

PLEUROTUS MITIS

This fungus is attacking Abies pectinata north of the Lake of Thun in Switzerland. The stands were established in old meadows about 50 years ago and are below the altitudinal limits where silver fir occurs naturally. Furthermore the seed is probably not of a suitable race. It was bought from Hamburg, but where it originally came from is unknown. Picea excelsa was artificially infected only. Fungus has not been found elsewhere in Switzerland or Europe as a parasite.

POLYPORUS SCHWEINITZII

On Pinus strobus. Fructifications on the ground, evidently coming from the roots of a living tree 24 in. d.b.h. Koninklyk Royal Park, Apeldoorn, Holland.

On Pseudotsuga taxifolia. A number of conks on the ground in a 50-year-old stand with no other conifers present. Must indicate some root and butt rot. Conks close to large trees. Schovenhorst, near Apeldoorn, Holland.

On Larix europaea. Conks around the butt of a tree 20" d.b.h. Eberswalde, Germany.

On Pseudotsuga taxifolia. Conks occasional on the ground and rot in the butt in a 40-year-old stand. Eberswalde.

On Pinus strobus. Conks occasional on the ground in a 100-year-old ornamental plantation. No other conifers nearby. Pechteich, near Eberswalde.

Saw no P. schweinitzii on the several forests visited in the vicinity of Munich.

PSEUDOMONAS RUBEFACIENS

Below the hill along the road between the Wageninsche Berg Hotel and Renkum, Holland there was a row of old poplars which were heavily cankered, mostly on the branches but also on the trunks. The trees were being felled but I could not find out why.

Koning is working on bacterial canker at Baarn. Method of infection in nature is unknown. She is very successful with wound inoculations, using the bacterial exudate from infected trees as the inoculum, with typical cankers resulting. Wound inoculations with a pure culture of the bacterium has resulted only in a bark anthracnose followed by healing (the annual type of canker). In the exudate from infected stems a yeast quickly appears and this may have a part in producing the typical canker. There is great difference in the susceptibility of poplars, the American Populus deltoides missouriensis being relatively resistant while P. trichocarpa is susceptible. P. angulata is a synonym for P. deltoides missouriensis.

At Durlach near Karlsruhe examined a hardwood stand in the Rhine valley. The stand is largely made up of poplars with some Fraxinus excelsior and Alnus glutinosa. The poplars are mostly P. canadensis and P. monolifera with some P. robusta and a little P. balsamifera. The oldest three of the first 2 species of poplar were 55 years and of fine form while others were 28 years old. All poplars planted but P. nigra is native a few kilometers distant. The wood of P. robusta is too soft and the trees very subject to frost cracks. The wood of P. balsamifera is too brown. All these poplars remain sound until about 60 years old when some trunk rot develops. No bacterial canker but some damage by poplar borer.

In a 45-year-old stand of P. monolifera and P. canadensis the growth had been remarkably good and the largest of the trees were 48 in. d.b.h. However part of this stand had been clear cut and replanted with the same species of poplars about 4 years ago. Growth of this plantation (second generation of poplar on this area) is very poor and the trees are severely damaged by poplar borer, although there is no bacterial canker. A new canal was constructed here a few years ago, lowering the water table and the soil has become very heavy and hard.

P. canadensis has a much straighter stem than P. monolifera, but the wood of the latter is better.

Along the Rhine River was an 8-year-old stand of P. robusta. Fine form, rapid growth, no bacterial canker and practically no poplar borer. An adjacent stand 5-years-old had a height of 7 meters. Alnus incana of same age interplanted here was 1/2 - 2/3 as tall as poplar. No canker.

Examined plantations of P. canadensis and P. monolifera of several ages up to 33 years. No bacterial canker but there was a little injury by poplar borer.

Spacing in plantations is 5 x 5 meters.

PSEUDOTSUGA TAXIFOLIA

A stand of 35-year-old Pseudotsuga taxifolia (coast form) was seen in the Forest of Kootwyk, Kootwyk, Holland which was growing at the rate of 200 cubic feet per acre per year, the trees ranging from 8 to 12 inches d.b.h. This is a remarkable growth. The stand was on a light, sandy soil which had formerly been farm land. All the trees had been pruned to a height of 16 to 18 feet.

A stand of 80-year-old trees of fine form, large diameter, and considerable height in the Koninklyk Royal Park (Apeldoorn, Holland), originally planted in mixture with Pinus strobus but the latter was so badly suppressed it had to be removed. Nearby is a 70-year-old stand, with slightly smaller trees, but stand is more dense.

Most Douglas fir is pruned artificially to a height of 16 to 18 feet in Holland.

At Eberswalde, Douglas fir 45 years old is as large as Pinus silvestris 100 years old.

In the Forst Freising (el. 1700 ft.), at Freising near Munich a 45-year planted stand of P. taxifolia was the same height as a 77-year stand of A. pectinata naturally reproduced with the opening filled in by planting.

In Forst Tharandt there was a 55-year-old mixed stand of P. taxifolia and Picea excelsa. The Douglas fir ranged from 14 to 20 inches d.b.h., just about twice the diameter of the spruce.

PULP - STAIN

Rennerfeldt at the Botanical Garden in Gothenburg, Sweden is investigating the fungi causing stain in pulp. He finds that many wood-destroying fungi stain pulp as well as the true stain fungi, but that the wood destroyers are difficult to identify because they do not fruit. Lignasan and its Swedish equivalent, pulvausan, have been found to be by far the best chemicals for preventing stain in pulp and the cost is reasonable; about 1 kroner or 24 cents (U.S.) per ton of pulp. About 200 grams of chemical per ton of pulp is used. It is applied in solution, a roller picking up the chemical from a vat and as the pulp goes through the roller, 1 side is treated. When the pulp is folded, a treated side is placed in contact with an untreated. This method seems simpler than spraying.

RACES OF DOUGLAS FIR

The races of Pseudotsuga taxifolia are of great importance to foresters in Germany and in fact in all Europe because of the extremely different rate of growth and reaction to disease and insects. As delimited by Henry there are the following: green or coast form (P. douglasii); gray, intermountain, intermediate, or transitional form (P. douglasii var. caesia); and the blue or Rocky Mountain form (P. glauca). Again these may be named as varieties viz. P. taxifolia vars. viridis, caesia and glauca. They are really growth forms and are better considered as varieties than species. They can best be referred to as coast form, intermountain form, and mountain form; while the last two can be grouped under one name, mountain forms. Names dependent on color are misleading, for although the coast form trees are always green, the mountain and intermountain forms, particularly the latter, often contain green as well as gray and blue individuals.

The origin of most stands of Douglas fir in Holland and Germany is unknown, so there is a constant need to determine the three forms. For this various characteristics have been determined, but even so it is not always possible to be absolutely sure of a given tree or stand.

If crushed the needles of the mountain forms have a much more pungent or resinous odor than those of the coast form.

Idioblasts are always present in the needles of the mountain forms but are found sparingly and then only in needles fully exposed to light in the coast form (Liese). Should be fully investigated.

At Buunderkramp (near Wageningen, Holland) there was a 30-year-old stand with the three forms mixed. Rhabdocline pseudotsugae severe on the mountain forms, coast form not infected; Chermes cookeyi severe on coast form, occasional on intermountain form, mountain form not infested. Where seen at several places in Holland and at Eberswalde, Germany, Phomopsis pseudotsugae was confined to the coast form.

Liese's method of preparing Douglas fir needles for studying idioblasts is as follows: upper surface of needle is lightly rubbed with emery paper; overnight in 95% alcohol; 5 - 10 minutes in phloroglucin and H Cl (probably 1% phloroglucin, the same as used for wood); wash in alcohol and mount in concentrated glycerine. Idioblasts show pink to red under low power of microscope.

In the sample plots at Stroe and at Speulder Bosch in Holland for testing the provenance of Douglas fir seed, the coast form is free from Rhabdocline but is moderately infected with Phomopsis pseudotsugae and Chermes cooleyi, the mountain forms are moderately to heavily attacked by Rhabdocline but are practically free from Phomopsis and Chermes, although a little occurs on the intermountain form.

RHABDOCLINE PSEUDOTSUGAE

This fungus is widespread throughout Holland and Germany, but is confined to the mountain forms of Pseudotsuga taxifolia, never being found on the coast form. According to Liese it was first thought to have been introduced from England on nursery stock but he now feels convinced that it spread across the channel by wind-borne spores.

Van Vloten has described 5 types of trees in the reaction of their needles to Rhabdocline:

0 - only yellow spots; needles become infected, some of the cells are killed, but there is no further development of fungus.

I - same yellow spots as above; but the mycelium does not die out in all places, so there is some development in the 2-year-needles and after the second winter there are necrotic spots on the 2 - and sometimes on the 3-year-old-needles.

II - yellow spots rather indefinite; after first winter some necrotic spots on 1-year-needles with apothecia and also necrotic spots on 2- and 3-year-needles with apothecia.

III - no yellowing; isolated necrotic spots and good apothecia, quite large after first winter. Necrotic spots never on 2- and 3-year-needles. Many needles not infected.

IV - all needles covered with necrotic spots towards end of

first winter and abundant apothecia which on the average are not so large as in type III. All needles cast by late June.

With type O it may happen that some needles will become quite yellow and be cast in late June or July when infection of these current season's needles occurred in late May or early June.

Elimination of Douglas firs susceptible to Rhabdocline before they are large enough to cross pollinate would be wise in Europe. Foresters will not agree because many infected trees make fair growth.

In the nursery area of the Forst Freising, Freising near Munich (el. 1700 ft.) on April 1, 1939 a few saplings were seen lightly infected with R. pseudotsugae, with one tree very heavily attacked. Adelopus was also abundant on these trees but apparently not yet damaging.

Münch is convinced that R. pseudotsugae was introduced into Germany from Great Britain, most likely in 1926 when 1,000,000 or more Douglas fir transplants were purchased there. The two points of introduction were Hamburg and the Belgian frontier from which the fungus spread very rapidly. He does not believe that the fungus spread across the channel by wind-blown ascospores.

In Forst Tharandt on Douglas firs from sapling to pole size, both mountain and coast forms, there was no Rhabdocline (4/5/39). Why?

In Forst Proskau (el. 600 ft.), Proskau near Oppeln, there was one small plantation (1/4 acre) of 30-year-old P. taxifolia (coast form) but no Rhabdocline.

In Neubersteich Park, a 15-year-old plantation of P. taxifolia (see description under Adelopus) had no Rhabdocline (4/12/39).

On various groups of P. taxifolia (mostly coast form) from saplings to small poles up to 20 years old in the Forst Falkenberg, Falkenberg bei Oppeln, Ober Schlesien, there was no Rhabdocline.

Rhabdocline pseudotsugae has not been found in Switzerland (Burger). This is because the prevailing wind is from the southwest toward Germany during the period in the spring and early summer when the spores are in the air. This idea proposed by me was concurred in by Gäumann, who also felt that in time the fungus would reach Switzerland moving slowly against the prevailing wind. It is only in winter that winds are from the north. Also in my opinion the fungus may be accidently introduced by man.

Münch thinks that after the fungus was introduced from Great

Britain into Germany on nursery stock in 1926, that the first spread was largely by means of nursery stock from Halstenbeck (south of Hamburg) shipped to various parts of Germany. Also the introduction along the Belgian frontier which apparently came from Belgium may have been by nursery stock from Halstenbeck to Belgium or by nursery stock directly from Great Britain to Belgium. A study of the yearly spread of the fungus on Münch's maps certainly lead one to agree with his conclusions.

This fungus is now in southern Sweden, having been carried on the wind from the Island of Bernholm in the Baltic Sea (Lagerberg).

At Warnemunde on the Baltic where there were Douglas firs of sapling size, both coast and mountain forms, no Rhabdocline was found.

SMOKE INJURY

There is a forest near Hindenburg (Ober Schlesien) which was formerly mostly P. silvestris and P. excelsa, both native and growing very well on good soil. Twenty years ago large collieries and industrial plants started in this locality, and because of smoke many trees have already been killed, while the others are dying or very unhealthy. The forest is ruined and in time will be composed of poor hardwoods (birch, oak, etc.) and very poor P. silvestris. Spruce will be entirely eliminated. The damage is not like the actual "burning" of foliage seen around smelters in the United States but consists of slow decline and general unhealthy appearance of the needles; a dull, dirty green instead of a bright, glossy green. The sulfur in the smoke removes the lime from the upper layers of the soil, making it unsuitable for tree growth.

The Forst Martineau, now known as the Stadtwald Beuthen, near Beuthen (Ober Schlesien) was also suffering severely from smoke injury. The needles of all the conifers were coated with soot. More than 100 species of trees were being tried here for smoke resistance and Populus canadensis so far is the most resistant hardwood and P. strobus the most resistant conifer. Picea excelsa is particularly susceptible to smoke (Von Schroeder).

In the sections of Ober Schlesien away from the industrial zone the soil is good and the forests are excellent; Picea excelsa, Pinus silvestris, A. pectinata, L. europaea, Q. pedunculata, Q. sessiliflora, B. alba (verrucosa), Fraxinus excelsior, F. silvatica and other hardwoods all being native.

At Töging near Mühldorf in Ober Bayern there is a disease of Picea excelsa characterized by progressive dying back from the top caused by a heavy defoliation. The 1-year-old needles have a peculiar yellowish mottling resembling that caused by Chrysomyxa abietis and

in the late spring and summer these needles are cast. Some trees have been killed, others are moribund, and these are intermingled with perfectly sound trees. Pinus silvestris associated is not affected nor is Alnus incana and other hardwoods, nor the shrubs, annual plants and farm crops. The disease was attributed to smoke or dust from a large aluminum works at Tögingen, but chemists have not found sufficient dust or gases in the air to cause the disease while Gäumann employed by the company and Münch by the Barvarian authorities have both reported against smoke. The disease was less on spruce within 1 kilometer of the factory and directly in line with the drift of the smoke by the prevailing wind from the west, than it was 3 kilometers to the west where the smoke is rarely carried. Also some diseased trees were found 12 kilometers west of the factory, and 2 small trees with the characteristic, mottled 1-year-old needles, 20 kilometers west. The stacks at the plant are quite low so the gases are not diffused and also gas and dust escapes from the ovens almost at ground level. The disease was not noticed until some years after the aluminum plant (now 15+ years old) started operations.

SOIL

In northern Germany, Pinus silvestris is not satisfactory on soils that are too good (rich). Although the trees grow well the branches are too large which reduces the quality of the timber (Zimmerman). This difference between stands on very good soil and on poorer soil was seen in the vicinity of Eberswalde.

German foresters are now largely convinced that pure stands of Picea excelsa and Pinus silvestris have resulted in soil deterioration, so that they are now trying to develop mixtures; underplanting P. silvestris with Quercus rubra (borealis) particularly, although Fagus silvatica is also used (Wollenweber). Such underplanting was seen in many stands of Pinus silvestris in northern Germany.

There is no soil deterioration resulting from pure stands of P. silvestris in northern Germany, but this does occur with pure stands of Picea excelsa in Saxony (Liese and Zimmerman).

In the Forst Bad Berka there was a stand of Pinus silvestris on too rich soil that was more suitable for beech, oak and other hardwoods. The result was rapid growth of the P. silvestris but with very large branches which did not prune well thus greatly lowering the quality of the timber. The most satisfactory pine is on lighter and sandier soils (De Marées).

Fomes annosus causes more butt rot in Picea excelsa on rich soils, particularly agricultural, than on poorer soils because the richer soils contain much more nitrogenous material (nitrogen) which favors the fungus (Münch).

On soils that are too good, P. silvestris develops branches that are too large. Also the size of branches varies with the race of pine, but within a race the size of branches is also influenced by soil (Münch and Trendelenburg).

In northern Germany there has been serious soil deterioration from pure stands of Pinus silvestris even though the tree is native. The virgin stand consisted of P. silvestris, with Fagus silvatica, Quercus robur and probably other hardwoods. This was cut away and pure pine planted. The first generation (rotation) gave a fine yield of say 500 cubic meters per hectare, the second of about 200 c.m., and the third was practically worthless yielding only 150 c.m. to practically nothing. An examination of the soil showed a hard pan in the soil formed because of improper decomposition. This hard pan was rich in nutrients but in a non-available form. After clear cutting the soil was ploughed to a depth of 1 meter which broke up the hard pan and brought it to the surface where it decomposed (broke down) in 3 or 4 months. Lime was then added to the soil and the area planted to a mixture of P. silvestris with a hardwood, usually Fagus silvatica or Carpinus (hornbeam) although Alnus incana was also used. The hardwood leaves resulted in normal decomposition of the humus through the proper microflora and microfauna with no development of hard pan. The yield returned to its original volume in time. Consequently today beech and oak are commonly mixed with P. silvestris even though little or no yield is ever obtained from the hardwoods (Heske).

Pure stands of Picea excelsa have also resulted in soil deterioration where the tree is native, although not naturally in pure stands. This can best be seen in the Böhmerwald, adjacent to Bavaria where the original virgin forest, consisting of 60 - 70% spruce (Picea excelsa is native and attains its optimum development in the Böhmerwald) and the remainder composed of Fagus silvatica and Abies pectinata, still exists side by side with the first to the third generation of pure planted spruce. The development of 300 years can thus be seen. The first generation of pure planted spruce yields as much or more wood volume per hectare than the virgin forest, the second generation less, and the third generation still less. Apparently the first generation uses up the accumulated nutrients in the soil, which are not renewed in sufficient quantity by pure spruce so there is a steady deterioration in the site reflected in constantly lessening yield. There is a marked change in the species of annual and perennial plants comprising the vegetation. Spruce is shallow rooted, silver fir and beech are deep rooted, so the latter two species bring up nutrients from the lower layers of the soil which are then transferred to the upper layers through the litter. In addition beech is particularly valuable because it brings up a great deal of lime from the lower layers, which is then added to the upper layers by decomposition of the leaves, preventing compacting of the soil and over-acidification. Soil de-

terioration results of course in less vigorous stands and an increase in infection by native fungi and insects (Heske).

The Dauerwald idea is only one step in correction of these artificial pure stands, that is from even-aged to uneven-aged. It is helpful, but the complete correction can come only through restoration of the original stand composition (Heske).

In the Forst Tharandt it is now the practice to plant a mixture of P. excelsa, P. silvestris, L. europaea and F. silvatica.

The same deterioration through pure spruce as in the Böhmerwald has occurred over extensive areas in Saxony (Heske).

In the Staatsforst Landskron (see description under D. willkommii) a mixed stand of P. excelsa, L. europaea, P. silvestris, and a little A. pectinata on very fine soil had grown splendidly, particularly spruce and larch; but the soil was too rich for the pine as was shown by the large branches which lower the quality of the timber.

In the valleys and lower slopes in Switzerland, according to Burger, the original stand was hardwoods (F. silvatica mostly, some Q. robur and other species) with a little P. excelsa. However silviculture of the hardwoods was not easy and the wood was not constantly in good demand, so that when the oak particularly and some of the other hardwoods were cut for railroad construction about 80 years ago, these mixed hardwood stands were largely replaced by plantations of pure spruce. These pure stands are now in the second generation and the yield has been good and the financial return much greater than from hardwoods. However the growth is beginning to show signs of falling off and in many stands the yield is already much reduced because of butt rot largely caused by Fomes annosus and to a lesser degree by Armillaria mellea. The soil has changed from its original character of a good porous loam with well decomposed humus to a pronounced podsol soil with a heavy accumulation of raw humus. Consequently with what has happened to pure spruce in Bohemia and Saxony as a warning, the Swiss are now converting the pure spruce stands in the lowlands into mixtures of beech, spruce, and silver fir. Also striving to secure natural reproduction and plant as little as possible.

According to Badoux pure planting of spruce in Switzerland began about 80 years ago because Germany had set the fashion.

See also notes on Larix leptolepis.

SWEDEN

In the general region of Linköping which is in central Sweden in the Southern Coniferous Region, the principal trees were Picea

excelsa and Pinus silvestris usually in mixture with the former predominating numerically. Some stands were seen with P. silvestris forming the overstory and P. excelsa the understory. Betula verrucosa was the most common hardwood, often occurring abundantly among the conifers. Most of the coniferous stands seemed to be naturally reproduced. A few Larix europaea were seen here and there but this species is not native to Sweden. As the east coast was approached (Norrköping to Stockholm), P. silvestris became numerically more predominant than P. excelsa.

An examination of Lagerberg's exhibit in Stockholm showed that most of the forest tree fungi in Sweden are also found in New England; this being particularly true of the wood destroying fungi. Some are different, but closely related species.

SWITZERLAND

There are three main regions in Switzerland from the forestry standpoint viz. the Plateau (the lowlands which are not a true plateau), the Jura (the lower mountains), and the Alps (the higher elevations). Originally the Plateau was largely hardwoods, principally beech and oak with some maple, ash, birch, etc. The conifers, - spruce, fir and larch were in the Jura and the Alps, with the addition of Pinus cembra in the Alps (Burger and Badoux).

On the Plateau north of Zurich the predominant species in the original hardwood forest were Quercus robur and Carpinus betulus while south of Zurich Fagus silvatica was predominant. In the forest stands Acer Pseudoplatanus is the usual maple while in the fields it is A. campestris (Gäumann).

There are no regulations governing the importation of living plant material into Switzerland. With 900 kilometers of frontier to watch, bordered by Germany, Italy and France all of which have such regulation, the Swiss feel that the cost would be out of proportion to any benefit.

There are only two serious forest diseases in Switzerland caused by fungi, viz. Adelopus needle cast and white pine blister rust (Burger, Badoux and Gäumann).

TSUGA HETEROPHYLLA

In Koninklyk Royal Park (Apeldoorn, Holland) is a plantation of Tsuga heterophylla covering a few hundred square feet. Stand is 30 years old, trees about 35 feet high, and every tree had forked one or more times just at ground level resulting in 2 - 4 or even 5 stems per tree, - like sprout hardwoods. Trees of this type are economically worthless. According to v.d. Haare this bad form characterizes this species in Holland. Source of seed unknown.

At Bad Berka, Germany this tree was being grown in the nursery. The seed came from Washington, the seedlings were straight without indication of forking, but according to de Marées seedlings from seed of unknown origin had forked badly.

WOUNDS - DISEASE

Throughout the German forests there is a tremendous amount of wounding on conifers by deer (Reh= roe / buck, Rotwild = red deer, Hirsch = stag) and measures are taken to protect the trees such as scratching the bark with a scribe, wire around the trunk, or tying pruned branches around the trunk. These wounds result in considerable rot particularly in Picea excelsa and in Abies pectinata. Fire wounds are practically unknown, lightning wounds are occasional on conifers and hardwoods, and frost cracks are common, particularly in hardwoods.

In the Staatsforst Landskron (see description under D. willkommii) most of the deer were shot during the Czech administration so there is practically no wounding and consequently little trunk rot of spruce and fir. Also natural reproduction flourishes because it is not browsed by the animals.

In Forst Langenbrand (northern Schwarzwald) wounds on A. pectinata and P. excelsa caused by deer are common. Damage by deer browsing on A. pectinata is very severe, this species being a particularly favorite browse. Many of the small trees look like ponderosa pine repeatedly browsed by sheep in the Southwest. Inside a fenced area, established three years ago, the reproduction is very abundant and no longer injured.

Hail wounds are abundant in German forests, particularly on hardwoods, and on F. silvatica are the usual infection courts for Nectria ditissima.

INDEX OF PERSONS

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Münch, Prof. Dr. E. Forstbotanisches Institut, Amalienstrasse 52, München 13, Germany.

Praschma, Graf. Forst Falkenberg, Falkenberg bei Oppeln, Ober Schlesien, Germany (forest owner).

Querengässer, Oberforstmeister Dr. F. Reichsforstamt, Leipziger Platz 11, Berlin, Germany.

Radler, Forstmeister. Forst Proskau, Proskau bei Oppeln, Ober Schlesien, Germany.

Rohde, Forstmeister Dr. Theo. Bad Hersfeld, Bez Kassel, Im Stift 8, Germany.

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Trendelenburg, Dr. R. Leiter der Holzforschungsstelle an der Technischen Hochschule, München 27, Germany.

Van de Haare, Jonkheer van Suchtelen. Chief, Forest Service of Holland.

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Von Schroeter, Herr F. Präsident, Deutschen Dendrologischen Gesellschaft, Neubersteich (Neoborowiz) Gleiwitz, Ober Schlesien, Germany.

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